

U University of Lowell
Continuing Education

One University Avenue
Lowell, MA 01854



1988—90 Catalog of Undergraduate Studies

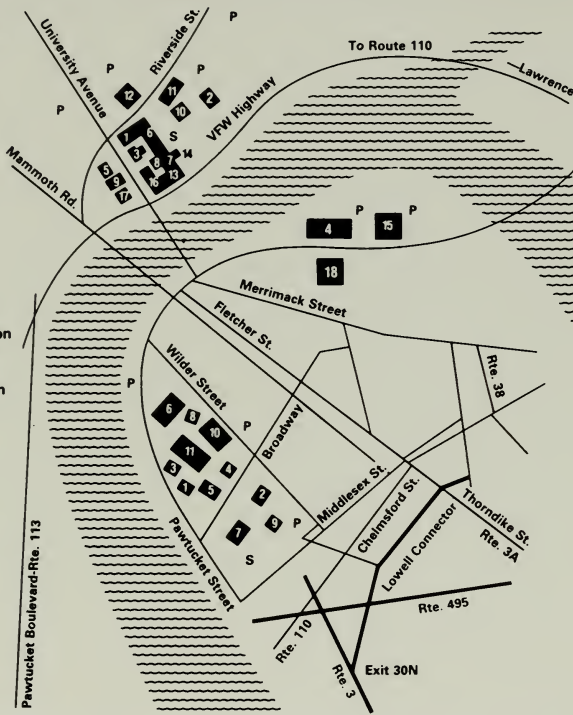
Map of the University

North

- 1 Ball Engineering Center
- 2 Costello Gym
- 3 Cumnock Hall
- 4 Dormitories
- 5 Eames Hall
- 6 Engineering
- 7 Falmouth
- 8 Kitson
- 9 Alumni/Lydon Library
- 10 Energy Center
- 11 Olney
- 12 Olsen
- 13 Pasteur
- 14 Power Plant
- 15 Research Foundation
- 16 Southwick Hall
- 17 Smith Hall
- 18 Fox Student Union
- P Parking
- S Security

South

- 1 Allen Hall
- 2 Coburn Hall
- 3 Concordia Hall
- 4 Dining Hall
- 5 Dugan Hall-Admissions
- 6 Durgin Hall
- 7 Mahoney Hall
- 8 O'Leary Library
- 9 Power Plant
- 10 Student Union
- 11 Weed Hall
- P Parking



TO NORTH CAMPUS

From Route 495

Follow 495 north or south toward Lowell, and take the Lowell Connector. From the Connector take exit 5N, Thorndike St. Bear right off exit ramp, heading north on Thorndike. Follow Thorndike to end (street name changes to Fletcher after it intersects Dutton St.) At the end of Fletcher turn right onto Pawtucket St., then first left onto the Textile Bridge. Across bridge is U Lowell North Campus.

From Route 128

Follow 128 north or south to Burlington area; take Rt. 3 North. On Rt. 3 take exit 30N onto Lowell Connector. From the Connector take exit 5N, Thorndike St. Bear right off exit ramp, heading north on Thorndike. Follow Thorndike to end (street name changes to Fletcher after it intersects Dutton St.) At the end of Fletcher turn right onto Pawtucket St., then first left onto the Textile Bridge. Across bridge is U Lowell North Campus.

TO SOUTH CAMPUS

From Route 495

Follow 495 north or south toward Lowell, and take the Lowell Connector. From the Connector take exit 5N, Thorndike St. Bear right off exit ramp, heading north on Thorndike. Turn left onto Broadway, and follow to intersection of Broadway and Wilder Streets, at the U Lowell South Campus.

From Route 128

Follow 128 north or south to the Burlington area; take exit 33B to Rt. 3 North. On Rt. 3 take exit 30N onto the Lowell Connector. From the Connector take exit 5N, Thorndike St. Bear right off exit ramp, heading north on Thorndike. Turn Left on Broadway, and follow to intersection of Broadway and Wilder Streets, at the U Lowell South Campus.

Photos & Artwork

Cover Photo

David Petty Photography

Cumnock Hall, located on the University's North Campus, is the central office for the Division of Continuing Education

University Map

Porras & Lawlor Design

Photos of the University

David Petty Photography, pages:

2, 5, 6, 22, 52, 58, 60, 78, 80, 81, 84, 86, 88, 91

Photos of the University & Downtown Lowell

Deborah Mayerson, pages:

9, 27, 62, 71, 94

Marvin Lewiton Photography

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* *abbreviated headings*



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* *abbreviated headings*



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Message from the Director

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I am pleased to welcome you to the many programs of the University of Lowell's Division of Continuing Education. Now in its 60th year, Continuing Education is a multi-faceted institution within a large, comprehensive university. As one of the largest Continuing Education units in New England (with over 15,000 students), we are pleased and proud of our varied offerings.

What we bring to the adult student is opportunity and access: opportunity for working adults to enrich their lives, enhance their professional credentials and succeed in their personal and career goals; and access to the outstanding faculty, facilities and cultural resources of a great urban university.

We invite you to read through these pages and explore our credit course offerings. I hope that you will feel free to contact any member of the staff if you have questions about our programs, and I wish you a pleasant and rewarding experience at the University of Lowell.

E. Yalouris
Director

About the University

The University of Lowell was formed in 1975 through a merger of Lowell State College and Lowell Technological Institute. Each of these institutions was established in the 1890's, Lowell State College as a teacher's college and Lowell Technological Institute to prepare students for the textile industry. Lowell State College was chartered in 1894, became a four-year institution in 1932 and, in 1960, added non-teaching programs and a Liberal Arts curriculum. The College granted degrees in education, health professions, liberal arts, sciences and music.

From the time of its origin in 1895, Lowell Technological Institute provided applied and practical educational programs. The control of the school was transferred to the state in 1918, and in 1928 it was granted collegiate status. In 1953, it became a multi-purpose technological institute. Prior to its merger with Lowell State College, the Institute phased out its textile curricula; it extended its offerings in engineering, technology, science, business administration and industrial management; and it received authorization to offer doctorate degrees.

The University occupies 35 buildings on three campuses (north, south, and west) and has a faculty in excess of 500 and a student enrollment of more than 14,000. It is comprised of seven colleges, a graduate school, and the Division of Continuing Education, which serves an additional 15,000 students.

Mission of the University

The University of Lowell is publicly supported by the Commonwealth of Massachusetts and offers degree programs at all levels through the doctorate. Although undergraduate program emphasis is in business, engineering, health, music, and science, the University strongly believes in the values of a liberal arts education for intellectual development and as a major component of professional preparation. Graduate program emphasis is in areas where there are strong regional needs or where the University possesses superior resources.

The University is committed to the promotion of scholarly research and creative, artistic achievement. Recognizing its role as a public institution, the University is actively involved in community service through instruction, research, consulting, cultural events, and Continuing Education. Finally, the University implements the principles

of equal opportunity and affirmative action and ensures that all students and employees are guaranteed the benefits of a just and equitable system.

Academic Computer Center

The University academic computer center, located in the Olsen building, provides a wide range of facilities and services in support of classroom teaching and research at both the undergraduate and graduate level. The central computer facility consists of a cluster of two DEC VAX 8650 computer systems employing the VAX VMS Operating System and utilizing many peripherals which include ten disk storage units, a line printer, two magnetic tape units and numerous communications equipment. This system primarily supports a vast time-sharing environment with a batch processing option. Access to these resources is available from any area in the University through an ever expanding telecommunications network. The operating system software includes Assembler Language, APL, BASIC, C, COBOL, FORTRAN, LISP, Pascal, and a library of application packages including SPSSX, TSP, BMDP, IMSL, MINITAB, SIMSCRIPT, MPOS, SPICE, ACSL, MAXSYMA, etc. These computer facilities are supported by the academic computer center organization.

In addition to the central computing facilities supported by the academic computer center, there are several minicomputer systems and several hundred microcomputers installed in various colleges and departments throughout the University. These facilities, which are operated and maintained at the college or the department level, include the following: VAX 8650, VAX 8700, VAX 8550, VAX 11/780, 11/750, 11/730, micro VAX(five), PDP 11's, Apollo network (40 nodes), Computervision, Data General MV/400(two), Hewlett Packard-1000, Wang VS/80(two), VS/45(two), and numerous Zenith, IBM, Apple, DEC and other micros. Most of these systems are either linked or have access to the University-wide telecommunications network.

University Libraries

The University libraries, which consist of the Alumni/Lydon Library (North Campus) and the O'Leary Library (South Campus), include over 300,000 books and periodicals and a large number of such non-print materials as video



tapes, films and microforms. The O'Leary Library provides resources in the social sciences, humanities, and health areas and houses the ERIC microfiche collection (Educational Resources Information Center). Music collections and facilities of O'Leary Library include listening stations, audio recordings, and over 7,000 music scores. The Alumni/Lydon Library houses collections for engineering, science, and business. The Center for Lowell History (in the Boott Mill Complex, downtown Lowell) contains special collections of the University, including the holdings of the American Association of University Women, Greater Lowell Chapter; Boston and Maine Railroad Historical Society; Lowell Historical Society; Lowell Museum; Manning Family; Middlesex Canal Association; Proprietors of the Locks and Canals on the Merrimack River; University Archives; and a collection of regional histories. Other valuable resources include educational media and New England maps published by the Geological Survey of the U.S. Department of the Interior. The University libraries provide interlibrary loan services and also function as a U.S. Government depository.

Accreditation and Professional Memberships

The University of Lowell is an accredited member of the New England Association of Schools and Colleges. Professional programs at the baccalaureate level also are accredited by the following national associations:

- Accreditation Board for Engineering and Technology
- American Assembly of Collegiate Schools of Business
- American Physical Therapy Association

- National Accrediting Agency for Clinical Laboratory Sciences
- National Association for Industrial Technology
- National Association of Schools of Music
- National Council for the Accreditation of Teacher Education
- National League for Nursing

Additionally, specific programs have been reviewed by the following associations to ensure compliance with applicable professional standards:

- American Chemical Society
- Interstate Certification Compact

The following programs offered through Continuing Education are accredited by the Technology Accreditation Commission of the Accreditation Board for:

- Engineering and Technology
- Civil Engineering Technology
- Electronic Engineering Technology
- Mechanical Engineering Technology

Accreditation indicates that the University is recognized and approved by regional and national associations concerned with the quality of higher education and it assures that study undertaken here has transfer value to other accredited institutions of higher education. The University is also a member of the following associations:

- American Association of Colleges for Teacher Education
- American Association of Colleges of Nursing
- American Council on Education
- Association for State Colleges and Universities
- College Entrance Examination Board
- Council of Colleges of Arts and Sciences
- National Association of Summer Sessions
- National Association of State Directors of Teacher Education and Certification
- National University Continuing Education Association
- New England Board of Higher Education

About Continuing Education



The aim of Continuing Education is to provide a variety of sound programs for a broad adult constituency at the lowest possible tuition. By defining and implementing a mission that is closely integrated with the needs of the students it serves, the Division of Continuing Education at the University of Lowell has established itself as a major force in continuing higher education in New England.

History

The development of Continuing Education at the University of Lowell parallels the growth of Lowell Technological Institute. Beginning in 1928, courses for textile workers were offered in the afternoon and evenings to teach industrial and commercial applications. In 1953, when Lowell Tech became a multi-purpose technological institute, it offered an evening and summer school to help meet the needs of part-time students and college students seeking to accelerate course work. With the creation of the University of Lowell in 1975, offerings in education, health professions, liberal arts, sciences, and music were added to the Lowell Tech offerings.

Currently, Continuing Education has four distinct service areas: Undergraduate degree programs, non-credit courses in Community Education, Special Programs, and Summer School, during which graduate, undergraduate and non-credit programs are offered.

Academic Degree Programs

A primary purpose of Continuing Education is to provide college credit courses and degree programs to a variety of adult learners. Students enroll in programs to acquire extensive practical background and skills, for professional advancement, to facilitate career changes, and for personal enrichment and satisfaction. University faculty and experienced professionals teach a wide spectrum of credit courses leading to associate's and bachelor's degrees. The Division sets policies and schedules with the working person in mind. Career oriented curricula in many fields are available on a part-time, evening basis.

The Division of Continuing Education attracts people of all ages, cultural and educational backgrounds. The Continuing Education student population includes transfer students from area community colleges, people returning to school, and individuals who work full time in business, government, hospitals, schools and other institutions.

College of Engineering

Associate's Degree

- Civil Engineering Technology
- Electronic Engineering Technology
- Mechanical Engineering Technology

Bachelor's Degree

- Civil Engineering Technology
- Electronic Engineering Technology
- Mechanical Engineering Technology
- Industrial Technology
- Manufacturing Option
- Water and Industrial Wastewater Technology Option
- Plastics Technology Option

College of Liberal Arts

Associate's Degree

- Public Service: Administration of Criminal Justice

Bachelor's Degree

- Public Service: Administration of Criminal Justice
- Social Sciences
 - Concentrations in Psychology, Sociology, History, Political Science

College of Management Science

Associate's Degree

- Management
- Accounting
- Banking

College of Pure and Applied Science

Associate's Degree

- Applied Chemistry
- Applied Mathematics
- Computer Mathematics Option
- Information Systems

Bachelor's Degree

- Applied Chemistry
- Applied Mathematics
- Computer Mathematics Option
- Information Systems

Community Education Program

Credit-free courses at the University are among the most diverse and dynamic offerings in Continuing Education. They were created for adults whose interests range from personal enrichment to professional advancement. Currently, courses are offered in the arts, careers and communicating, finance and real estate, health and fitness, language, sports and recreation and refresher subjects. The main office of Community Education is located in the new Downtown Center for Continuing Education in the Boott Mill Complex on French Street. In this spacious and modern building, the program will continue to offer the latest of adult education

courses at affordable prices and at convenient times.

In addition, Community Education sponsors the Learning in Retirement Association, cooperative education for retired people, which is also housed in the Downtown Center. Classes, trips, concerts and lectures are self-taught and reasonably-priced, and membership is growing steadily. For further information on Community Education, please call the Office of Continuing Education at (508)452-5000, ext. 2221.

Summer School

Continuing Education operates a full summer schedule, providing graduate as well as undergraduate courses during evening and day hours. Individuals enroll in the University Summer School to accelerate their program of study, make up course work, facilitate career advancement, or for personal enrichment. Some of the new programs to be offered in the 1989 Summer School include a Drama and Film Institute, a Writing Program, Hellenic Studies, a college experience for gifted high school students interested in computer science and engineering, and a residential English as a Second Language Program.

Registration for any summer session may be made by phone, mail, or walk-in procedures. The summer tabloid, which lists the variety of courses and special programs, is available by calling the Office of Continuing Education. Summer dormitory housing may be arranged for those who wish to enjoy the full academic and social life that summer at the University of Lowell offers.

Special Programs

The Office of Special Programs manages over 150 professional seminars and conferences annually. These programs range from small, single-session seminars to large academic conferences featuring regional and national topics. Most seminars are taught by University faculty and highlight their research and academic specialties.

Among the facilities available at the University are classrooms, state of the art laboratories, concert and lecture halls, athletic complexes and the Downtown Center for Continuing Education. This latest facility offers a convenient downtown location with comfortable meeting rooms and exhibit space for poster sessions. Some dormitory housing and meal service is offered to participants in summer programs as a low-cost alternative to local hotels.

Course Notation System

Each course offering is designated by a two-digit prefix and a three-digit course number. The two-digit college prefix identifies the college department. The three-digit course number identifies the course level.

Course Prefixes

College of Engineering

15	Civil Engineering Technology
17	Electronic Engineering Technology
20	Industrial Technology
23	Mechanical Engineering Technology
27	Plastics

College of Liberal Arts

42	English
43	History
44	Criminal Justice
45	Philosophy
46	Political Science
47	Psychology
48	Sociology
50, 51, 52, 54, 55, 56	Languages
57, 58	Art
59	Technology, Science and Human Values

College of Management Science

67	Accounting
68	Economics
69	Banking, Management

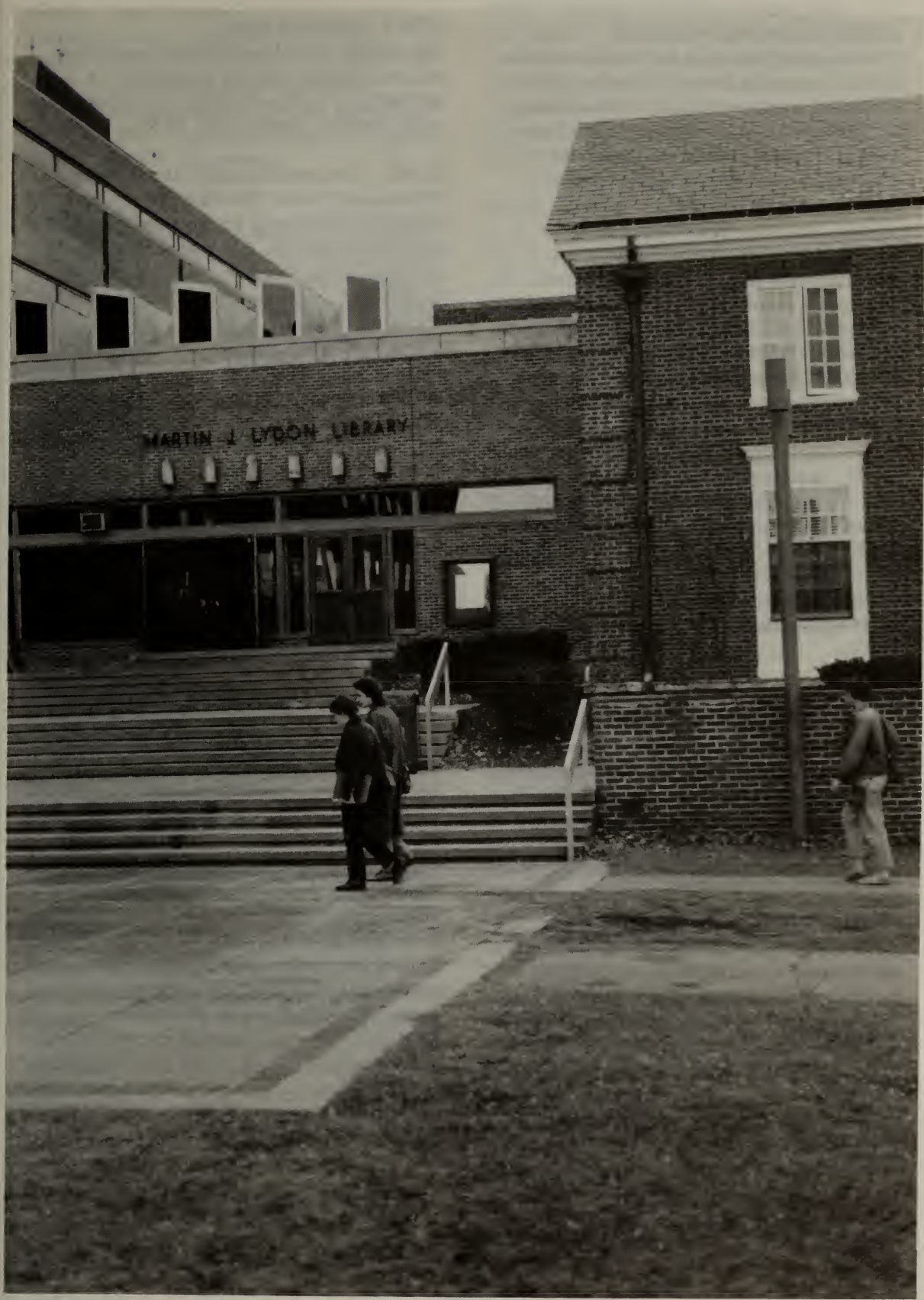
College of Pure and Applied Science

81, 83	Biology
84, 86	Chemistry
89	Geology
90	Mathematics
92	Computer Mathematics Option
99	Physics

Course Numbers

- 001-099: pre-freshman and special undergraduate courses; do not carry baccalaureate degree credit
- 100-299: lower division undergraduate courses
- 300-499: upper division undergraduate courses
- 500-599: graduate courses open to upper division undergraduates with consent of instructors and chairpersons
- 600-699: for graduate students only

Course Descriptions



Accounting

67.201 Accounting Principles I

Presents a comprehensive and detailed exposure to basic accounting theory. Beginning with the accounting equation, the student is introduced to the accounting cycle, preparation of the Statement of Financial Position and the Income Statement, and accounting for the assets of a firm. One session per week, 3 credits.

67.202 Accounting Principles II

Emphasizes the accounting for corporations, treatment of stockholders' equity, earnings and dividends. Examines the Statement of Changes in Financial Position, cash flow causes and effects, and financial statement analysis. One session per week, 3 credits. Prerequisite: 67.201.

67.301 Intermediate Accounting I

This course examines the generally accepted accounting principles relating to the preparation of financial statements. The student will study in depth the valuation and disclosure problems associated with the assets of the firm. One session per week, 3 credits. Prerequisite: 67.202.

67.302 Intermediate Accounting II

This course continues the in-depth study of the valuation and disclosure problems associated with corporate liabilities and stockholders' equity. Emphasis is placed on the opinions of the Accounting Principles Board and Financial Accounting Standard Board. One session per week, 3 credits. Prerequisite: 67.301.

67.311 Managerial Accounting

An in-depth examination of the use of accounting systems for managerial decision-making. Budgeting, forecasting, and cost accumulations systems which relate to the manufacturing firm will be studied. One session per week, 3 credits. Prerequisite: 67.202. (For non-accounting majors.)

67.362 Business Law I

Principles of commercial law encompassing a study of contracts, agency, employment, commercial paper and sales including the Uniform Commercial Code. One session per week, 3 credits.

67.363 Business Law II

The analysis of the legal principles underlying real and personal property, corporations, partnerships, trusts, and estates. One session per week, 3 credits. Prerequisite: 67.362.

67.401 Advanced Financial Accounting

This course explores theoretical and practical problems in accounting for large, multicorporation business entities. Consolidation, mergers, and home office/branch accounting receive in-depth study. One session per week, 3 credits. Prerequisite: 67.302.

67.411 Cost Accounting

An examination of the manufacturing function from the view of the cost accountant. Managerial control of the elements of product costs will be studied with an emphasis on cost accumulation systems both historical and estimated. One session per week, 3 credits. Prerequisite: 67.202.

67.421 Auditing

An examination of purposes of financial auditing and operations auditing. The following topics will be examined in depth: auditing, standards, professional ethics, legal responsibilities, internal control, audit evidence, financial statements, disclosures, audit reports, management advisory services, and internal auditing. One session per week, 3 credits. Prerequisite: 67.302.

67.431 Federal Income Taxes

This course deals with the basic rules and regulations of the Internal Revenue Code as it affects the individual and the corporation. An understanding of the code is developed through lectures, assigned readings, research, and the solution to a wide variety of problems. One session per week, 3 credits. Prerequisite: 67.202.

Art

57.251 Visual Design I

A study of design principles and how they articulate structure, space, and form. The development of visual ideas that relate to painting, sculpture, graphic arts and architecture. 3 credits. Area II core course except for students in the College of Engineering.

57.255 Drawing I

A foundation in basic concepts and techniques using a variety of drawing media. The emphasis is on realism and its application to the realm of ideas. A wide range of assignments are given to develop graphic expression. One session per week, 3 credits. Area II core course except for students in the College of Engineering.

57.271 Painting I Studio

Oil painting techniques are taught as vehicles for serious creative expression. A variety of assignments will be given to help the student gain proficiency in the use of color technique and subject matter. One session per week, 3 credits.

58.101 Appreciation of the Visual Arts

Appreciation of the visual elements used in art such as color, line, and shape. Emphasis is placed on modes of representation, styles, media, technical procedures, and principles of design. One session per week, 3 credits. Area II core course.

58.203 Survey of Art I

A survey of the major Western arts from earliest time to the Middle Ages presented chronologically. Emphasis is placed upon the changing nature of the style and content within sequential cultural contexts. The aim of the course is to introduce the student to basic critical and art historical methods. One session per week, 3 credits. Area II core course.

58.204 Survey of Art II

A survey of the major Western arts from Renaissance to the 20th century presented chronologically. Emphasis is placed upon the changing nature of the style and content within sequential cultural contexts. The aim of the course is to introduce the student to basic critical and art historical methods. One session per week, 3 credits. Area II core course.

Banking

69.101 Principles of Banking

This course fulfills the same role as the "Principles of Bank Operations" course it replaces; however, it provides an updated and broader perspective of the banking industry. Principles of Banking touches on nearly every aspect of bank functions. Included is a comprehensive introduction to banking in today's economy. Discussions on specific topics are presented in an easily accessible form. The language and documents of banking, check processing, teller functions, deposit function, trust services, bank bookkeeping, and bank loans and investments are some primary topics. The course ends with a discussion of the bank's role in the community. One session per week, 3 credits.

69.104 Analyzing Financial Statements

This course offers the student tools and techniques necessary for the evaluation of financial

condition and operating performance of a modern business enterprise. The course is divided into four parts: Financial Statement Analysis and Accounting; Financial Statements and Business Funds Flow; Tools of Financial Statements Analysis; and the Technique of Financial Statement Analysis. One session per week, 3 credits. Prerequisite: 67.201.

69.105 Consumer Lending

This modular course emphasizes the pragmatic "how-to" details of installment credit. Topics covered are principles of credit evaluation, open-end credit, marketing bank services, collection policies and procedures, legal aspects, financial statement analysis, direct and indirect installment lending, leasing and other special situations, installment credit department management, insurance rate structure and yields. One session per week, 3 credits.

69.106 Real Estate Finance

This course provides a background in the varied real estate mortgage credit operations of commercial banks. It treats the main areas of real estate by concentrating on the following broad areas: 1) the manner in which funds are channeled into the mortgage markets; 2) the financing of residential property; 3) the financing of special purpose property; and 4) the administrative tasks common to most mortgage departments. One session per week, 3 credits.

69.107 Bank Investments

The objectives of this course are to explain the nature of the more important bank investments, to demonstrate the relationship of investment management to other functional areas of the bank, and to discuss the factors that affect investment strategies and decisions. Emphasis throughout is on the basic principles with which investment personnel should be familiar - fundamentals such as the nature of risk, liquidity, and yield; how each is measured; and how they are related. One session per week, 3 credits. Prerequisite: 69.101.

****69.109 Marketing for Bankers**

This course presents marketing as a broad concept. It deals with concepts and philosophies of marketing; information, research, and target; the marketing mix (product strategy, distribution strategy, advertising and sales promotions, personal selling, and pricing strategy); and the methods of market planning. One session per week, 3 credits.

****69.114 Retail Banking**

Staff Leader, financial expert, sales manager ... today's successful bank manager needs to be all these and more. The Retail Banking Series shows you how to perform each of these roles more effectively using accepted management principles in the banking environment. The Series consists of three separate mini-courses tailored to those managing or preparing to manage human and financial resources in today's fast-paced banking world. They are Retail Management, Sales Management, and Financial Performance of Banks. One session per week, 3 credits.

****69.116 Commercial Bank Management**

A complete introduction to the handling of day-to-day bank activities, for example: the formula-

tion of objectives and policies; the management of assets and liabilities; the sources and uses of funds; the administration of deposits; loans and other investments and the short-term management of funds. This edition also incorporates case studies to aid the student in acquiring bank management skills. One session per week, 3 credits. Prerequisite: 69.101.

**** 69.117 Law and Banking: Principles**

This course is a banker's guide to law and legal issues with special emphasis on the Uniform Commercial Code. This course includes up-to-date summaries of law pertaining to contracts, real estate and bankruptcy. It also contains a complete chapter on the legal implications of consumer lending. A comprehensive glossary of legal terminology related to banking and commercial transactions is included. One session per week, 3 credits.

****69.118 Law and Banking: Applications**

This course is an introduction to laws pertaining to secured transactions, letters of credit and the bank collection process. This course also discusses check losses and a broad range of legal issues related to processing checks. The material on secured transactions contains up-to-date summaries of the laws related to collateral, perfection and default. Interesting case studies are used to illustrate important legal points related to banking practices. One session per week, 3 credits. Prerequisite: 69.117.

****69.119 Commercial Lending**

This course provides entry-level commercial loan officers with knowledge and skills to service the vital needs of corporate clients. Emphasizes: Organization of commercial lending operations, role of commercial lending in bank profitability, loan interviewing and credit investigation, loan documentation, administration, and closing, preventing and resolving problem loan. One session per week, 3 credits. Prerequisites: 67.201, 67.202.

****This course may be used as a Banking elective but not as an Accounting or Management elective.**

Biological Sciences

81.111 Principles of Biology I

Introduction to biological systems above the unit organismal level. Study of plants and animals with respect to reproduction and development, behavior, genetics, evolution, ecology and biogeography. One session per week, 3 credits.

81.112 Principles of Biology II

An introduction to the structure and function of biological processes at the sub-cellular, cellular, and organismal levels. Discussions include metabolism, growth, differentiation, and physiology of plants and animals. One session per week, 3 credits. Prerequisite: 81.111.

83.101 Life Science I

An introduction to the study of Biology which considers first the chemical basis of life and then the earth's environment as a community in which plants and animals live, interact, and demonstrate genetic variations which enable them to adapt to changes and evolve. One session per week, 3 credits. Corerequisite: 83.103. Area III Science lecture core course.

83.102 Life Science II

Emphasis on systems structure and function. The cellular organization of plants and animals will lead into physiological processes of higher organisms such as nutrition and digestion, cellular metabolism, circulatory, respiratory, excretory, nervous, reproductive and musculoskeletal systems. Hormonal control and immunity will also be considered. Among the topics covered are chemistry relating to life processes, genetics which covers human inheritance as well as DNA replications, transcription and mutagenesis. Also: behavior, evolution, ecology. One session per week. 3 credits. Corequisite: 83.104. Area III Science lecture core course.

83.103 Life Science Laboratory I

Laboratory work associated with 83.101. One session per week, 1 credit. Corequisite: 83.101. Must be taken with 83.101 for Laboratory Science Area III lab requirement.

83.104 Life Science Laboratory II

Laboratory work associated with 83.102. One session per week. 1 credit. Corequisite: 83.102. Must be taken with 83.102 for Laboratory Science Area III lab requirement.

Chemistry

84.111 General Chemistry

A one-semester survey of the principles of inorganic chemistry: the structure of matter, the quantitative aspects of chemical reactions, solution chemistry, including acid-base chemistry and ionic equilibria. One session per week, 3 credits. Corequisite: 84.113.

84.113 General Chemistry Laboratory

The laboratory course corequisite with 84.111 with experiments designed to cover the structure of matter, the quantitative aspects of chemical reactions, and solution chemistry, including acid-base chemistry and ionic equilibria. One session per week, 1 credit.

84.121 Chemistry I

Class and demonstration. An introduction to the basic concepts of chemistry. Topics include chemical calculations, atomic structures, the periodic table, basic bonding theory, solutions, liquids, gases. One session per week, 3 credits.

84.122 Chemistry II

Class and demonstration. A continuation of 84.121. Topics include thermodynamics, kinetics, acids and bases, introduction to organic chemistry, chemical equilibrium, precipitation reactions, electrochemistry. One session per week, 3 credits. Prerequisite: 84.121.

84.223 Principles of Organic Chemistry I

Discussions of structure, classification by functionality, nomenclature, synthesis and reactions, mechanisms of reactions of organic compounds. One session per week, 3 credits. Prerequisite: 84.122. Corequisite: 84.225 or permission of Coordinator.

84.224 Principles of Organic Chemistry II

A continuation of first semester subject 84.223. One session per week, 3 credits. Prerequisite: 84.223. Corequisite: 84.226 or permission of Coordinator.

84.225 Principles of Organic Chemistry Laboratory I

Laboratory work is scheduled to accompany topic presentations in the lecture phase of the course (84.223) and will be devoted to product separation and purification techniques, methods of synthesis of important compounds, and instrumental analytical techniques. One session per week, 1 credit. Corequisite: 84.223.

84.226 Principles of Organic Chemistry Laboratory II

A continuation of the first semester laboratory course 84.225. One session per week, 1 credit. Prerequisite: 84.225. Corequisite: 84.224.

84.314 Analytical Chemistry II

This course will introduce the student to modern instrumental methods of chemical analysis. Included are such topics as ultraviolet, infrared nuclear magnetic resonance, emission and atomic absorption spectroscopy. Mass spectrometry, chromatography, thermal and electrochemical methods of analysis will be discussed. One session per week, 3 credits. Prerequisites: 86.122, 99.133. Corequisite: 84.316. Offered in alternate years.

84.316 Analytical Chemistry Laboratory II

Laboratory experiments designed to complement the coverage of topics in 84.314. One session per week, 1 credit. Prerequisite: 86.122. Corequisite: 84.314. Offered in alternate years.

84.334 Advanced Inorganic Chemistry

An introduction to modern theories of atomic structure and chemical bonding with emphasis on physical chemical principles and properties. Considerable time will be spent on coordination compounds including topics such as descriptive chemistry, biochemical importance, and ligand field theory. One session per week, 3 credits. Prerequisite: 84.345. Offered in alternate years.

84.344 Physical Chemistry I

The 84.344-84.345 sequence covers basic physical chemical topics: laws of thermodynamics, solutions, chemical and phase equilibria, electrochemistry, kinetics, atomic and molecular structure. One session per week, 3 credits. Prerequisites: 86.122, 92.126, 99.133. Corequisite: 86.355.

84.345 Physical Chemistry II

See description under 84.344. One session per week, 3 credits. Prerequisite: 84.344. Corequisite: 84.347.

84.347 Physical Chemistry Laboratory II

Laboratory work designed to exemplify the principles of chemical kinetics, equilibrium and spectroscopy. One session per week, 1 credit. Corequisite: 84.345.

86.121 Analytical Chemistry A

Class and laboratory. The principles and calculations of gravimetric and volumetric analysis. One session per week, 3 credits. Prerequisites: 84.122, 92.115.

86.122 Analytical Chemistry B

Class and laboratory. Advance concepts in wet methods of analysis. One session per week, 3 credits. Prerequisite: 86.121.

86.352 Chemical Applications

A study of the chemical principles applied to one or more areas of industrial technology. One session per week, 3 credits. Prerequisite: 84.345. Offered in spring 1990 and alternate years thereafter.

86.355 Experimental Physical Chemistry

Laboratory work designed to exemplify the principles covered in 84.344. One session per week, 1 credit. Corequisite: 84.344.

86.361 Advanced Organic Chemistry I

An in-depth coverage of properties and reactions of organic compounds stressing such aspects as synthetic methods and reaction mechanisms. One session per week, 3 credits. Prerequisites: 84.224, 84.345. Offered in alternate years.

86.362 Advanced Organic Chemistry II

A continuation of advanced level study of organic compounds stressing synthesis and reaction mechanisms. One session per week, 3 credits. Prerequisite: 86.361. Offered in alternate years.

86.421 Special Topics in Chemistry

An in-depth treatment of one or more areas of advanced chemistry or industrial applications of chemistry. Students enrolling for the course must have the permission of the Chemistry Coordinator. One session per week, 3 credits.

86.471 Industrial Chemistry

Discussion of essential chemical principles in selected areas of industrial concern, including the effect of industrial processes on the environment. One session per week, 3 credits. Prerequisites: 84.224, 84.345. Offered in fall 1989 and alternate years thereafter.

86.481 Chemistry of High Polymers I

The physical and organic chemistry of monomers and polymers, including a consideration on non-bonding forces, spectroscopic methods of structure determination, fractionation and

thermodynamics. One session per week, 3 credits. Prerequisites: 84.224, 84.345. Offered in alternative years.

86.482 Chemistry of High Polymers II

A continuation of 86.481. Topics presented will include methods of molecular weight determinations for polymers in solution, kinetics of condensation and addition polymerization, and mechanisms of free radical and ionic polymerization. One session per week, 3 credits. Prerequisite: 86.481. Offered in alternative years.

Civil Engineering Technology

15.113 CAD

Class and laboratory. By the use of Interactive computer graphics workstations, students will create two civil/architectural drawings which involve the process of inserting and modifying lines, arcs, text, dimensions, and other geometric entities. One session per week, 2 credits. Prerequisite: 23.111.

15.123 Surveying I

Class and laboratory. Principles of data gathering by surveying processes. Theories and methods of instrumental techniques for measurement of length, directions, coordinates, areas, volumes and topographic data. Introduction to and use of electronic distance measuring equipment. Problems are used to illustrate processing of field work data. Illustrative fieldwork projects to give facility in basic surveying techniques. One session per week and five Saturdays of fieldwork, 4 credits. Prerequisite: 92.115, 23.111.

15.124 Surveying II

Class and laboratory. A continuation of 15.123. Application of basic surveying techniques of engineering problems implicit in transportation engineering, industrial and domestic housing, utilities for the safety and convenience of humans, use of land resources and the supply and control of water. Fieldwork projects typical of the applications of surveying to engineering. One session per week and five Saturdays of fieldwork, 4 credits. Prerequisite: 15.123.

15.224 Material/Structural Laboratory

Experimental study of construction materials such as steel, concrete; and the properties of soil. Study will also include flexure test of beam and load test of truss. One session per week, 1 credit. Prerequisites: 15.251, 15.253, 15.254.

15.237 Statics

The fundamentals of statics, including such topics as force systems, resultants, equilibrium, friction, first moments of masses and areas. One session per week, 3 credits. Prerequisites: 92.125, 99.131. Corequisite: 92.126

15.238 Dynamics (CE)

Laws of kinematics of particles and rigid bodies involving absolute and relative motion. Newton's law as applied to the kinetics of rigid bodies in motion. Principles of work and energy; impulse and momentum. One session per week, 3 credits. Prerequisite: 15.237.

15.239 Strength of Materials

Principles of strength of materials, centric, torsional and flexural loading, principle stresses, Mohr's stress cycle strain, temperature effects, shear and moment diagrams. One session per week, 3 credits. Prerequisite: 15.237.

15.242 Steel Design I

Selection and proportioning of structural steel members to resist axial, shearing, bending and combined stresses. The design of simple riveted, bolted and welded connections. Use of current AISC Specifications and Commentary. One session per week, 3 credits. Prerequisite: 15.251.

15.246 Introduction to Hydraulics

Properties of fluids, principles of hydrostatic pressure, fluid flow with applications to orifices, tubes, weirs, and pipes. Two demonstration laboratory sessions will be held during the semester. One session per week, 3 credits. Prerequisite: 15.237.

15.247 Hydraulics Laboratory

Fundamentals of measurements in the general area of hydraulics. Laboratory topics include friction losses in pipes and valves, flow through venturi and orifice, hydraulic ram, study of open channel flow, etc. One session per week, 1 credit. Prerequisite: 15.246.

15.251 Structural Analysis I

Analysis of statically determinate structures. Reactions and stresses, framed structures, beams, trusses, graphic statics, roof trusses, truss and girder bridges, long span bridges, and lateral bracing and portals, solution of trusses and frames by a general purpose structural analysis computer program. One session per week, 3 credits. Prerequisite: 15.239. Corequisite: 15.253

15.253 Reinforced Concrete I

The selection and design of reinforced concrete members to resist axial, shearing, bending and combined stresses by the Working Stress Design method and the Strength method. Design of rectangular beams, T-beams, and slabs. Use of current ACI Specification and Commentary. One session per week, 3 credits. Prerequisite: 15.239; Corequisite: 15.251.

15.254 Soil Mechanics I

An elementary treatment of the physical properties of soils such as bearing and shearing strengths, soil moisture content, compressibility, consolidation, and settlement. The applications of such soil properties to typical foundations as piles, caissons, and spread footings. One session per week, 3 credits. Prerequisites: 15.243, 15.239.

15.256 Water and Wastewater Laboratory

Experimental study chemistry of water and wastewater. Study includes basic laboratory techniques and procedures, water chemistry, turbidity, odor PH, taste and hardness, alkalinity, jar testing, BOD, COD, etc. One session per week, 1 credit. Prerequisite: 15.356.

15.257 Highway Elements

An integral presentation of the broad field of basic highway principles covering highway administration, economics and finance, planning, design, soils, drainage, earthwork operations, pavement, surface types, cements, and highway maintenance. One session per week, 3 credits. Prerequisite: 15.124.

15.352 Structural Analysis II

A continuation of 15.251. Deflection calculations for beams, trusses, and frames. Analysis of trusses, beams, and frames by energy methods and moment distribution. Solution of trusses and frames by a general purpose structural analysis computer program. One session per week, 3 credits. Offered in odd years only. Prerequisite: 15.251.

15.356 Environmental Technology

The chemistry and biology of water and wastewater, design of water treatment process, design of pipe and stream pollution. One session per week, 3 credits. Prerequisites: 84.111, 15.246.

15.383 Steel Design II

A continuation of 15.242. Design of beam-columns, moment-resisting connections, built-up plate girders, and composite beam and slab sections. Consideration of basic structural members as elements within frame and floor systems. One session per week, 3 credits. Offered in odd years only. Prerequisite: 15.242.

15.391 Reinforced Concrete II

A continuation of 15.253. The analysis of and design for the behavior of the basic concrete members on structural frames and floor systems. The use of design curves and graphs as an aid to the solution of practical problems. One session per week, 3 credits. Offered in even years only. Prerequisite: 15.253.

15.392 Soil Mechanics II

A continuation of 15.254 with emphasis on application of principles. The use of field and laboratory tests in the design of foundation and the treatment of embankments. One session per week, 3 credits. Offered in odd years only. Prerequisite: 15.254.

15.394 Soil Mechanics Lab

Common soil laboratory tests including soil classification graduate, atterberg limits, strength and compressibility tests. One session per week, 1 credit. Offered in even years only. Prerequisite: 15.254.

15.463 Construction Technology

A descriptive and analytical study of methods and equipment used in the planning and execution of construction projects; the critical path method of scheduling. One session per week, 3 credits. Offered in even years only. Prerequisite: 15.257.

15.470 Project Management

Development of management skills and techniques to plan, schedule, supervise and control projects. Project estimating, labor cost and productivity, specifications and contracts, time, cost and quality control, and project decision-making and financing. One session per week, 3 credits. Prerequisite: 15.463.

15.486 Transportation Elements

A continuation of 15.257. Presentation of selected topics in the field of transportation such as traffic, integrated public transportation, planning and developmental impact of transportation routes. One session per week, 3 credits. Offered in even years only. Prerequisite: 15.257.

15.495 Civil Engineering Technology Elective

Advanced topics from the sub-disciplines of Civil Engineering Technology; that is, structures, transportation, sanitary technology or soil mechanics. Offered at student request and conditional on sufficient enrollment. One session per week, 3 credits. Prerequisite: Completion of the required courses in the sub-discipline in which course is offered.

Computer Mathematics Option

Students registering for programming courses will be required to spend non-class time at the University's Computer Center.

92.202 Microcomputers and Applications Software

An introduction to the processing of information by microcomputers. Topics include computer logic, memory, input/output, and use of applications software including 1) spreadsheets, 2) word processors, 3) graphics 4) data bases. One session per week, 3 credits. No prerequisite

92.209 Introduction to BASIC

An introduction to the processing of information by computer. Computer logic, memory, inputs and outputs, timesharing, flow-charting techniques, and programming in the BASIC language. this course is for students with no prior programming experience. One session per week, 3 credits. Prerequisite: 90.111 or equivalent. Credit given for only one of 92.209 or 92.219

92.219 BASIC Programming

Programming in BASIC, including nested loops, subscripted variables, string manipulation, subroutines and advanced programming techniques. Prerequisite: 90.111 and working knowledge of some other programming language. One session per week, 3 credits. Credit given for only one of 92.209 or 92.219.

92.263 FORTRAN Programming

Programming principles of FORTRAN including input-output, arithmetic and control statements: arrays, functions and subroutines. Structures programming will be emphasized. Students will process several problems. One session per week, 3 credits. Prerequisite: 90.112 or 90.113.

92.265 Pascal Programming

An introduction to computer programming including the elements of algorithm design and data structures. The Pascal language will be used. Topics covered include: algorithm development by step-wise refinement, language control structures, functions and procedures, the standard data types, scalar data types, and an

introduction to structured types. The student will process a number of programs on the University computer. One session per week, 3 credits. Prerequisite: 92.263. Area III core course.

92.267 "C" Programming

Introduction to techniques of programming in "C". The language syntax, semantics, its applications, and the portable library are covered. One session per week. 3 credits. Prerequisite: 92.265

92.360 Introduction to Data Structures

Basic concepts of data, linear lists, strings, arrays and orthogonal lists. Trees and graphs. Storage systems and structures. Storage allocation and collection. Multilined structures. Symbol tables, searching and sorting (ordering) techniques. One session per week, 3 credits. Prerequisites: 92.265, 92.321.

92.363 SPSS

This course will deal with the computer analysis of data, derived from research conducted primarily in the social, behavioral, and life sciences. The course will include such topics as: data presentation, organization and coding; SPSS system, developing SPSS input deck with various control and procedure cards, generating SPSS files; data modification, recoding and transformation of data; file manipulation, producing input/output files, deleting, retaining, adding variables, etc.; various statistical procedures, from descriptive statistics to more complex multi-variate statistics. Data sets, including completed questionnaires, will be issued to students for practice in working with the SPSS system and for use in performing various functions, from encoding data to complete statistical analysis. One session per week, 3 credits. Prerequisite: knowledge of basic statistics.

92.364 Problem Solving with Pascal

This course is designed to be a practical problem-solving course, to give students further exposure to the topics covered in 92.265, and to provide the tools needed for software development. The course emphasizes these aspects of the programming problem-solving process: problem specification and organization, algorithms, coding, debugging, the elements of good programming style and the means of producing a high-quality finished product. Programming examples are chosen to span a wide range of

both numeric and non-numeric applications. One session per week, 3 credits. Prerequisite: 92.265.

92.365 COBOL Programming I

Programming principles of COBOL, the Common Business Oriented Language; identification, environment, data, and procedures divisions, introduction to compilation procedures and diagnostic processing. Programming of basic applications, such as inventory and accounting problems. One session per week, 3 credits. Prerequisite: 92.209 or 92.219.

92.366 Problem Solving with FORTRAN

Advanced FORTRAN Programming techniques including multi-dimensional arrays, all FORTRAN data types, character data, file manipulations, and advanced subprogram argument passing, and multi-dimensional array addressing. Additional topics include testing and debugging, numerical operating system, and implementation of algorithms. One session per week, 3 credits. Prerequisite: 92.263.

92.368 COBOL Programming II

A continuation of 92.365. Advanced programming problems in COBOL, discussion of COBOL systems software, sophisticated routines and generalized business file manipulation. One session per week, 3 credits. Prerequisite: 92.365.

92.455 Assembly Language Programming I

Absolute machine language coding and the symbolic programming language; the coding of practice problems on a high-speed digital computer using the basic computer instructions including arithmetic, input-out, logic, control operations and data manipulation. One session per week, 3 credits. Prerequisite: 92.263 or 92.265.

92.457 ADA

An introduction to the syntax and semantics of the programming language ADA, including data structures and types, control structures, tasks, packages and generics. Practical exercises involving the language will be included. One session per week, 3 credits. Prerequisite: 92.265.

92.461 Systems Simulation and Modeling
Procedures in model construction and computerized simulation, modeling tools and techniques, model conceptualization and implementation, selected applications of simulation. One session per week, 3 credits. Prerequisites: 92.263 or 92.265, 92.383.

92.462 Systems Programming
Basic concepts of assembly programs and compilers, macro-generators, utility programs, supervisions, monitors, and high-level languages. One session per week, 3 credits. Prerequisites: 92.265, 92.360.

92.463 Systems Design and Development I
A general study of the design and development of computer-oriented data processing systems including: the approach requirements of the system, developing the solution, data controls, system controls, system evaluation and reporting to management. One session per week, 3 credits. Prerequisite: 92.455.

92.464 Systems Design and Development II
A continuation of 92.463 including: finalizing and implementing the system, post-installation evaluation, and interdepartmental coordination, case studies. One session per week, 3 credits. Prerequisite: 92.463.

92.467 Assembly Language Programming II
A continuation of 92.455. Symbolic programming using advanced techniques including macro instructions, indirect addressing, file generation and processing, magnetic tape and magnetic disc applications. One session per week, 3 credits. Prerequisite: 92.455.

92.468 Microcomputer Principles and Applications
Current microcomputer practices covering both hardware and software including basic microcomputer instruction sets, operating systems, assembler and I/O programming, utilities, interrupts, and interfaces. Scientific, industrial and business applications throughout. One session per week, 3 credits. Prerequisite: 92.265.

92.469 Compiler Construction Techniques
Typical compiler organization is studied including symbol tables, various types of scans, object code generation, error diagnostics, and optimization

techniques. Parts of a classroom compiler are written by students. One session per week, 3 credits. Prerequisites: 92.360, 92.455.

92.470 Data Communications
Analysis and use of remote computing systems including time-sharing remote batch and real-time systems. Design characteristics, applications, data communication, economics and management of such systems. One session per week, 3 credits. Prerequisites: 92.265, 92.360.

92.474 Data Base Concepts
An introduction to data base directives, design element of 3 data bases, architectures, and commercial data bases will be presented. Students will participate in design of a large-scale data base application. Administration of the data base. Students will program the basic concepts on a machine. Prerequisites: 2 semesters of higher level language, excluding BASIC. One session per week, 3 credits.

92.476 Computer Organization
Covers much of the computer architecture knowledge necessary for the software engineer. Students are introduced to the representation of information and to the concepts of gates and elementary logic. Storage mechanisms and memory organizations are described and a functional layout of an elementary computer is given. Addressing methods are explained and various methods of I/O are discussed. The course is filled out with discussions covering microprocessors, large computers, parallelism, and distributed logic. One session per week, 3 credits. Prerequisites: 92.265, 92.455.

92.477 Information Systems I
Analysis and evaluation of third generation integrated software systems including hardware for requirements, routine and demand reports, architectural evaluation for integrated business function control and the data base design. One session per week, 3 credits. Prerequisite: Junior Status.

92.478 Information Systems II
Automated decision-making models, systems user consideration, the economics of MIS, detailed case studies of large-scale MIS including effects on management organization, personnel and data management. One session per week, 3 credits. Prerequisite: 92.477.

Criminal Justice

44.101 The Criminal Justice System

This course includes a brief history of the criminal justice system and an analysis of its structure and function. Required for all Criminal Justice majors and prerequisite to all courses in Criminal Justice. One session per week, 3 credits.

44.141 Police Functions: Theory and Applications

An examination of the historical development of police work with special emphasis on the conflicting role expectations facing the police officer. One session per week, 3 credits.

44.151 Introduction to Corrections

A comprehensive view of theory, practice and philosophy involved in the treatment of convicted law violators of all ages. One session per week, 3 credits.

44.221 Criminology I

The definition and nature of crime, criminal statistics, and a survey of theories of crime causation will be included. Required for all Criminal Justice majors. One session per week, 3 credits.

44.234 Criminal Law

The historical origins and development of criminal law from the early common law to contemporary decisions and statutes. Constitutional and statutory factors as they pertain to crime, defense, and crimes against persons and property will be considered. In addition, attention is directed toward limitations of criminal responsibility, capacity and the law of arrest. Sections of the Massachusetts Criminal Code and other statutes will be covered where applicable. One session per week, 3 credits. Prerequisite: 44.141.

44.243 Criminalistics I

Basic procedures in arrest, search and seizure, and the gathering as well as the evaluation of evidence as to admissibility, weight, and competence. One session per week, 3 credits. Prerequisite: 2 semesters of science.

44.244 Criminalistics II

Collections, identification, preservation, and transportation of physical evidence. The crime

laboratory and its effectiveness capabilities and limitations in assisting the police officer and utilizing physical evidence as a means of apprehension and/or conviction. One session per week, 3 credits. Prerequisite: 44.243.

44.261 Juvenile Delinquency

Causative factors in the development of youthful offenders will be examined. The development and philosophy behind treatment of juvenile court and clinic, training schools, and contemporary innovative practices will be covered. One session per week, 3 credits.

44.321 Criminology II

An examination of theories of criminal behavior, both historical and contemporary, and their impact on the evolution of punishment, treatment and rehabilitative practices. One session per week, 3 credits. Prerequisite: 44.221.

44.331 Penal Law

A study of the constitutional rights of incarcerated individuals, including major policy issues and trends associated with recent revisions of penal codes reflecting court decisions for the preservation of offenders' rights. One session per week, 3 credits. Prerequisite: 44.234.

44.335 Juvenile Court Philosophy and Practice

Examination of the civil procedures used in the juvenile court as opposed to the adversary procedures used in criminal court, together with a history of the development of the juvenile court and an examination of its constitutional basis. One session per week, 3 credits. Prerequisite: 44.261.

44.341 Comparative Police Systems

A study of various police systems on the national and international level and a comparison with local systems on the basis of organization, structure, and administration of law enforcement agencies. Agencies in Europe, United Kingdom, Soviet Union and other parts of the United States will be reviewed. One session per week, 3 credits.

44.351 Alternatives to Corrections

Modern trends in corrections, such as the community-based programs in work-release,

half-way houses, parole clinics, the therapeutic community, and team treatment concept in institutions are evaluated. One session per week, 3 credits. Prerequisite: 44.151.

44.354 Probation and Parole

The historical development of both probation and parole and an examination of their place in the criminal justice system. There will be an emphasis on recent trends including diversion, flat sentencing, week-end sentencing, and the problems resulting from departure from traditional practices. One session per week, 3 credits.

44.360 Minorities and the Criminal Justice System

Both social and legal consequences of racism and discrimination will be discussed as they pertain to minorities and the criminal justice system. Prerequisite: 44.234. One session per week, 3 credits.

44.370 Criminal Justice Planning and Evaluation

An introduction to the principles of administration, including planning, budgeting, labor relations, grantsmanship and evaluation, as they relate to the criminal justice manager. One session per week, 3 credits.

44.371 Criminal Justice Management

A continuation of 44.370. One session per week, 3 credits.

44.372 Issues in Correctional Administration

Specific analysis of the management of correctional institutions, including custody, classification, reception, programming, release, staffing, scheduling, collective bargaining, and other related issues. One session per week, 3 credits. Prerequisite: 44.371.

44.373 Issues in Police Administration

Specific analysis of the management of contemporary police force, including staffing, scheduling, training, collective bargaining, community relations, and other related issues. One session per week, 3 credits. Prerequisite: 44.371.

44.380 Selected Issues in Law and Justice

Topics chosen from current issues and problems in criminal justice. Subjects taken up in the course will vary but will include such questions as victimology, social and psychological aspects

of crime, crime control and deterrence, evaluation and policy research. One session per week, 3 credits.

44.390 Research Methods in Criminal Justice

An overview of the role of research in the criminal justice system, including terminology, standard methodologies, and elementary statistics. One session per week, 3 credits.

44.401 Seminar on Drugs

The course objective is designed to cover the problems of drugs, drug abuse, the law and its application. Treatment of and alternatives to drug rehabilitation will be studied in addition to the classification, identification, distribution, and control of drugs. One session per week, 3 credits.

44.490 Research Seminar in Criminal Justice

Specific practice in the definition, design and execution of a research project and an analysis of the impact of contemporary criminal justice research on policy development. One session per week, 3 credits. Prerequisite: 44.390.

44.496 Practicum - Field Experience

Assigned field work under supervision and with permission of coordinator designed to broaden the educational experience of pre-service students in law enforcement and corrections by providing exposure in selected correctional, law enforcement, probation and parole agencies within the area. This course is designed to provide a correlation of theoretical knowledge with practical experience in an area of particular interest to the students. One session per week, 3 credits.

UNIVERSITY OF LOWELL



COLLEGE OF
ENGINEERING

BALL ENGINEERING CENTER



Economics

68.201 Economics I (Microeconomics)

A study of the principles governing the production and exchange of goods and services. One session per week, 3 credits. Prerequisite: 90.111. Area I core course for Continuing Education students.

68.307 Government, Business and Society

An examination of the various governmental controls over business in the American economy. One session per week, 3 credits. Prerequisite: 68.201 or 68.202. Area I core course and Human Values core course for Continuing Education students.

68.202 Economics II (Macroeconomics)

A study of the principles governing the level of national income and employment. Examination of the commercial banking system, monetary and fiscal policy, the international economy, and alternative economic system. One session per week, 3 credits. Prerequisite: 90.111. Area I core course for Continuing Education students.

Electronic Engineering Technology

17.130 Electrical Basics and Laboratory

An introduction to the basic principles of electrical engineering, including the concepts of voltage, current, resistance, inductance, and capacitance. Ohm's Law, Kirchhoff's Laws, Thevenin's theorem and Norton's theorem. Alternating current concepts, frequency response and filters. The use of laboratory power supplies, and measuring instruments such as oscilloscopes, voltmeters, ammeters, and ohmmeters. Computer terminals are available in the laboratory and their use is expected. Written reports are required. Alternate lecture and laboratory sessions. Not available for EET majors. One session per week, 2 credits. Prerequisites: 42.226, 92.115, 92.219 or 92.263, and 99.132. (Replacement for 17.127)

17.131 Electronic Basics and Laboratory

A continuation and elaboration of the concepts covered in 17.130, Electrical Basics. Topics include diodes, transistors, and electronic amplifiers, power supplies, feedback and control systems. Magnetics and electromechanics, AC power systems, and rotating machines. Computer terminals are available in the laboratory and their use is expected. Written reports are required. Alternate lecture and laboratory sessions. Not available for EET majors. One session per week, 2 credits. Prerequisites: 17.130, and 42.226. (Replacement for 17.128)

17.132 Digital Basics and Laboratory

An introduction to number systems and digital logic, including both combinational and sequential digital logic networks. Topics include binary, decimal, octal, and hexadecimal number systems, base conversion, Boolean algebra, Karnaugh maps, and sequential counters. Computer terminals are available in the laboratory and their use is expected. Written reports are required. Alternate lecture and laboratory sessions. Not available for EET majors. One session per week, 2 credits. Prerequisites: 17.130 and 42.226. (Replacement for 17.129)

17.213 Electric Circuits

Electrical units; voltage, current, and resistance; energy, power, and charge; Ohm's Law, Kirchhoff's Current Law, and Kirchhoff's Voltage Law; simplification and conversion techniques for networks containing sources and/or resistance; Thevenin's and Norton's theorems; fundamentals of magnetism and magnetic circuits; meters and measuring. One session per week, 3 credits. Prerequisites: 90.113, 92.125 (may be taken concurrently), and 92.219.

17.214 Circuits and Laboratory I

A continuation of 17.213, Electric Circuits. Topics include sinusoidal waveforms, phasors, impedance, network elements, rheostats and potentiometers. Mesh and nodal analysis of ac circuits; series and parallel circuits, series-

parallel circuits, superposition, and Wye/Delta conversions. The use of power supplies, and measuring instruments such as oscilloscopes, voltmeters, ammeters, and ohmmeters. Computer terminals are available in the laboratory and their use is expected. Written reports are required. Alternate lecture and laboratory sessions, one session per week, 2 credits. Prerequisites: 17.213, 42.226, 92.126 (may be taken concurrently), and 92.115.

17.215 Circuits and Laboratory II

A continuation of 17.214, Circuits and Laboratory I. Topics include superposition, Thevenin's and Norton's theorems applied to sine wave excitations, maximum power transfer, real and reactive power, resonance, polyphase systems. Oscilloscopes, voltage, current, and phase measurements. Series and parallel sinusoidal circuits, series-parallel sinusoidal circuits. Series resonance, parallel resonance, and transformers. Computer terminals are available in the laboratory and their use is expected. Written reports are required. Alternate lecture and laboratory sessions, one session per week, 2 credits. Prerequisites: 17.214, 42.226, 92.126, and 92.115.

17.216 Advanced Circuits

An extension and elaboration of the principles covered in 17.213, 17.214, and 17.215. Analysis of circuits and systems undergoing transient conditions caused by a variety of excitations, both natural and forced, utilizing the Laplace-Transform method. Application to mechanical, fluidic, thermal circuits and filters are presented as an introduction to electromechanical, electronic, and control systems. One session per week, 3 credits. Prerequisites: 17.215 and 92.126.

17.317 Minicomputer Programming

An introduction to the fundamentals of absolute and symbolic programming. Typical digital computer organization and operation from a register reference point of view. Computer, instructions, word formats, and symbolic coding. Address modification, index register and looping. Use of system programs including the Debug, Editor, and Assembler. Subroutines, calling sequences, multiple entry, and return. Program assignments will be run on one of the University's minicomputers. One session per week, 3 credits. Prerequisites: 17.353, 17.356, 17.371, and 92.219 or 92.263.

17.350 Control Systems I

A basic course in feedback control theory, which applies Laplace transform and frequency response. Approximation techniques are developed to achieve an optimum design of a practical multi-loop servo having velocity feedback and integral-network compensation. The general time behavior of a control system is studied, including the use of error coefficients to compute the angular error of a radar tracking antenna. One session per week, 3 credits. Prerequisites: 17.216 and 92.126.

17.353 Digital Electronics

The building blocks and concepts associated with digital electronic networks. Combinational networks, Eber-Moll Transistor model, state devices, logic families (RTL, TTL, ECL, CMOS), read-only memories (ROM's), static and dynamic MOS random access memories (RAM's), programmable logic array (PLA's), and macro cell logic. One session per week, 3 credits. Prerequisites: 17.356 and 17.371.

17.355 Electronics & Laboratory I

An introduction to electronic signals and systems. Amplifier characteristics and two-port networks. Diode characteristics and applications. Rectifiers, power supplies, filters, comparators, and limiters. Computer terminals are available in the laboratory and their use is expected. Written reports are required. Alternate lecture and laboratory sessions, one session per week, 2 credits. Prerequisites: 17.215 (May be taken concurrently.), 42.226, and 92.126.

17.356 Electronics & Laboratory II

A continuation of 17.355, Electronics and Laboratory I. Waveform generators, junction field-effect transistors (JFET's), graphical analysis, small signal equivalent networks, biasing and multistage amplifiers. Computer terminals are available in the laboratory and their use is expected. Written reports are required. Alternate lecture and laboratory sessions, one session per week, 2 credits. Prerequisites: 17.215, 17.355, 42.226, and 92.126.

17.357 Electronics & Laboratory III

A continuation of 17.356, Electronics and Laboratory II, metal-oxide-semiconductor field-effect transistors (MOSFET's), bipolar junction transistors (BJT's), single and multi-stage amplifiers. Computer terminals are available in

the laboratory and their use is expected. Written reports are required. Alternate lecture and laboratory sessions, one session per week, 2 credits. Prerequisites: 17.356, 42.226, and 92.126.

17.358 Electronics & Laboratory IV

Single and multi-stage amplifiers, frequency response, feedback, analog integrated circuits, filters and oscillator circuits. Computer terminals are available in the laboratory and their use is expected. Written reports are required. Alternate lecture and laboratory sessions, one session per week, 2 credits. Prerequisites: 17.357, 42.226, and 92.126.

17.361 Project Laboratory A

Possible projects are outlined and discussed. Students submit detailed proposals. The best feasible projects are then assigned to teams of students for implementation. Use of the computer as a tool to solve experimental problems is encouraged. Written reports are required. One session per week, 2 credits. Prerequisites: 17.353, 17.358, and 17.365.

17.365 Applied Linear Devices

The linear and non-linear applications and the characteristics of linear integrated devices will be studied. Optimal use of industry published specifications, application notes, and handbook data will be stressed. Topics include operational amplifiers, regulators, comparators, analog switches, time function generators, instrument circuits, logarithmic circuits, computing circuits, and signal processing circuits. One session per week, 3 credits. Prerequisites: 17.350 and 17.357.

17.367 Digital Devices & Laboratory

An extension and elaboration of the topics covered in 17.353 Digital Electronics, 17.371 Logic Design I, and 17.372 Logic Design II. Topics include: logic devices (TTL, CMOS, ECL, and NMOS), interfacing between various logic families, propagation delay, three-state devices, totem pole and open collector structures and their uses, programmable logic devices, memory devices used as logic elements, digital timers, and clock generators. A class design project involving the above devices will be required, and approximately one-half of the course time will be an associated laboratory. Written reports are required. One session per

week, 2 credits. Prerequisites: 17.353, 17.371, and 17.372 (may be taken concurrently).

17.368 Data Conversion & Laboratory

A continuation of 17.367 Digital Devices and Laboratory. The fundamentals of data conversion devices including R/2R ladder networks, weighted resistor and weighted source networks, analog-to-digital and digital-to-analog converters, voltage-to-frequency and frequency-to-voltage converters, and sample and hold networks. Approximately one-half the course time will be an associated laboratory. One session per week, 2 credits. Prerequisites: 17.353, 17.371, and 17.372 (may be taken concurrently).

17.371 Logic Design I

A study of number systems, switching algebra, and combinational logic. Topics include: number systems; coding; switching algebra; minimization and decomposition of switching functions, using maps, tabular procedures and charts; basic logical gates and block diagrams; bilateral switching networks and threshold logic. One session per week, 3 credits. Prerequisites: 17.355, and 17.356 (may be taken concurrently).

17.372 Logic Design II

An extension of the principles of 17.371, Logic Design I to sequential networks. Topics include; synchronous sequential networks, state diagrams and tables, transition tables, state assignment, storage elements, excitation tables, partitioning, merger graphs and tables, implication graphs, fundamental mode asynchronous sequential networks, flow tables, races, cycles, and critical race free assignments. One session per week, 3 credits. Prerequisite: 17.371.

17.376 Electromagnetic Theory I

Review of vector analysis electrostatic theory and applications including electric field, potential, Gauss's Law, divergence, stored energy, boundary conditions, forces, dielectric materials, conductivity, electrostatic mapping, capacitance, Poisson's and Laplace's equations. Magneto-static theory, including the magnetic field, Lorentz force, motion of charged particles in combined electric and magnetic fields, Amperes Law, inductance, stored energy, boundary conditions, magnetic materials, magnetism and superconductors. Applications including two-wire transmission line, electrostatic shielding, electrostatic photography, precipitators, corona,

electron emission, bubble memory devices, MHD power generation, Hall effect, magnetic shielding, and magnetic circuit design. One session per week, 3 credits. Prerequisites: 17.358 and 92.234.

17.380 Microprocessor Basics

An extension of topics covered in 17.353, Digital Electronics, emphasizing and based upon an integrated set of microprocessor experiments and related lectures. Topics include: hexadecimal and decimal conversion, BCD arithmetic, microprocessor programming, immediate and direct addressing, arithmetic and logic instructions, branching, index and extended addressing, subroutines, memory circuits, data input and output, introduction to PIA, digital-to-analog and analog-to-digital conversion, interfacing, and various programming projects. Approximately one-half the course time will be an associated laboratory. One session per week, 2 credits. Prerequisites: 17.356 17.371.

17.382 Problems in E. E. Technology

The techniques covered in Pascal programming will be used extensively for the solution of problems related to electronic engineering technology. Various projects will be assigned to each student. One session per week, 3 credits. Prerequisites: 17.353, 17.358, 92.234, and 92.265.

17.391 Project Laboratory B

Students are required to submit project proposals compatible with the advanced technical electives offered. Teams are then assigned to implement selected projects. Use of the computer as a tool to solve experimental problems is encouraged. Written laboratory reports are required. Credit by examination will not be granted for this subject. One session per week, 2 credits. Prerequisites: 17.361, 17.367, 17.382, and 17.4 — E. E. Technology Elective.

17.392 Project Laboratory C

Students are required to submit project proposals compatible with the advanced technical electives offered. Teams are then assigned to implement selected projects. Use of the computer as a tool to solve experimental problems is encouraged. Written laboratory reports are required. Credit by examination will not be granted for this subject. One session per week, 2 credits. Prerequisites: 17.361, 17.367, 17.382, and 17.4 — E.E. Technology Elective.

17.459 Power Converter Design I

The design of modern switching and linear power supplies, basic voltage regulators and power converters, square-wave power converters and regulators, Compound regulating systems, thermal considerations, series-pass regulators, DC/DC converter design, switching regulators and converters. One session per week, 3 credits. Prerequisites: 17.350 and 17.365.

17.460 Power Converter Design II

A power converter design course dealing with the more popular types of modern high frequency switching converters at the 150 to 500 watt level. It is a continuation of 17.459, Power Converter Design I with emphasis on network analysis using Laplace Transforms and some basic programming. The analysis will be used to determine component stresses. Techniques for determining the stability of switching and linear regulators will be presented. One session per week, 3 credits. Prerequisite: 17.459.

17.469 Control Systems II

An extension of 17.350, Control Systems I. A practical and complex multi-loop servo is studied in detail. The servo has feedback of current, velocity, and position, along with integral compensation, and includes the dynamics of mechanical resonance in the gear train. The error due to static friction is analyzed. Sampled-data theory is presented, and applied to develop a method of dynamic computer simulation, which can be implemented in basic computer language. The servo system previously analyzed is simulated with this technique. One session per week, 3 credits. Prerequisite: 17.350.

17.473 Logic Design III

A continuation of 17.372 Logic Design II. Pulse mode asynchronous networks, iterative networks, the structure of sequential networks, sets, relations and lattices, state assignment using partitions, serial and parallel decomposition, decomposition with specified components, state identification and fault detection experiments, linear sequential networks, and applications of digital logic. One session per week, 3 credits. Prerequisite: 17.372.

17.477 Electromagnetic Theory II

Review of Maxwell's equations. The wave equation for free space propagation. Concept of a time varying electromagnetic field. Sinusoidal

plane waves. Planewaves in dielectric and conductive media. Poynting's vector, depth and penetration, force and radiation pressure, reflection of EM waves from perfect conductors, dielectrics, and multiple dielectrics. Quarter wave and half-wave matching, polarization, Brewster's angle, and surface waves. Introductory concepts in guided electromagnetic waves including transmission lines, waveguides, and antennas from the viewpoint of Maxwell's equations. One session per week, 3 credits. Prerequisites: 17.376 and 92.234.

17.478 Applied Electromagnetics

The conventional two-conductor transmission line theory is presented with emphasis on those results which can be applied to the analysis and design of waveguide transmission. A discussion of the most frequently used microwave oscillators, the magnetron and klystron, are presented. The traveling wave tube concept is emphasized. The interaction of microwave radiation with magnetic materials and practical devices of importance will be studied. Special problems encountered when microwave techniques and methods are extended to the millimeter-wave-length limit of the microwave domain will be reviewed. One session per week, 3 credits. Prerequisite: 17.477.

17.479 Optoelectronics

This course provides a theoretical and practical introduction to optical and electronic devices used for the emission, control, propagation and detection of optical radiation, and the processing of resulting signals. A review of the physics of optical radiation and an introduction of black body radiation, photometry, and radiometry. A survey of both classical and coherent radiation sources. The laser and its technological and telecommunication applications. The detection of optical radiation from the ultra-violet to the infrared. Detector characteristics. Optical components such as lenses, mirrors, beamsplitters, and telescopes used in the transmission and reception of optical radiation; filters, polarizers, modulators, scanners required to select, shape and direct optical radiation will be discussed and their application in systems of current interest presented. One session per week, 3 credits. Prerequisites: 17.368 and 17.376.

17.483 Microprocessor Hardware

An introduction to the designing of a 16 bit microprocessor system. The hardware requirements of interfacing the 8086 microprocessor to memory devices, EPROMS, dynamic RAMS and static RAMS as well as I/O devices are covered. The interface to the various microprocessor peripherals such as the Co-processor, Bus Arbiter, DMA Controller, Programmable Interrupt Controller, and Dynamic Ram Controller is investigated. The 8086 system is compared to the 68000 system. One session per week, 3 credits. Prerequisites: 17.367, 17.371, and 17.380.

17.484 Microprocessor Software

A study of the architecture and instruction set of the 8086 microprocessor. Subject areas include: addressing modes, data movement instructions, flag operations, arithmetic and logical instructions, bit manipulation instructions, primitive string operations, program control instructions, flowcharts, hardware control instructions, interrupt structures, and procedures. Some of the peripheral devices of the Intel family are covered as well. Students will be required to develop programs that exhibit their knowledge of both the instructions sets and good programming practices. The interpretation of written programs will also be investigated. One session per week, 3 credits. Prerequisites: 17.367, 17.371, and 17.380.

17.485 Communication Theory I

Introduction to information, transmission, and communication systems. Review of Fourier series, and Fourier integrals, discussion of amplitude and frequency modulation systems. An introduction to noise in electrical systems. One session per week, 3 credits. Prerequisite: 17.376.

17.486 Communication Theory II

A continuation of 17.485, Communication Theory I. Pulse amplitude modulation (PAM), pulse code modulation (PCM), and pulse position modulation (PPM) systems, will be discussed and analyzed. Propagation in free space, antenna theory and propagation characteristics of the ionosphere will be presented. One session per week, 3 credits. Prerequisites: 17.485, and 92.234.

17.487 Filter Design I

A review of network analysis. An introduction to synthesis, driving point impedance, approximation theory, and transfer function realization. One session per week, 3 credits. Prerequisites: 17.350 and 92.234.

17.488 Filter Design II

An introduction to the analysis and synthesis of active filters. Negative resistance, controlled sources, negative impedance converters and gyrators will be discussed. Course emphasis will be on the operational amplifier as a network element. One session per week, 3 credits. Prerequisite: 17.487.

17.489 Microwave Antennas

Introduction to the designs and performance of microwave antennas, finite element antennas, horn and dish antennas. Satellite terminal applications. Antenna, tracking/pointing, and RF component design projects. Link analysis. One session per week, 3 credits. Prerequisites: 17.358, 17.376, and 92.234.

17.490 Advanced Microprocessors

The designing of a 32-bit microprocessor system using the INTEL 80386 and MOTOROLA 68020, and the hardware requirements of interfacing the 32 bit data buses to memory devices is studied. The interface to the various microprocessor peripherals such as the INTEL 80387 and the MC68881 Co-processors as well as MC68851 Paged Memory Management Unit is investigated. System architecture including multitasking, virtual address translation, paging, and protection schemes are covered. One session per week, 3 credits. Prerequisites: 17.367, 17.371, and 17.483.

17.494 Telecommunications

Telephone channels systems objectives for human and machine interface. The switched telephone network hierarchy. Local channel performance, noise, echo, design loss and crosstalk. Frequency division multiplex systems. Time division, network design, topological considerations. Service availability, line usage and blocking. Facsimile, telex. Regulation of common carriers, tariffs. User applications include PABX system analysis. One session per week, 3 credits. Prerequisites: 17.216 and 17.371.

17.495 Microprocessor Control

An introduction to computer peripheral controllers that interface to mass storage devices and communication networks. The hardware requirements of interfacing to hard disk, tape, cassette, and floppy are studied. Topics considered are the various communication protocols and the interface to local communication networks such as Ethernet, and Starlan. Also considered are global communications using ASYNC, BISYNC, and SDLC/HDLC. The necessary requirements to interface an 80188 microprocessor to each controller will be defined. One session per week, 3 credits. Prerequisites: 17.367, 17.371, and 17.380.

17.496 Radar Systems

An introduction to radar system analysis. An overview of basic radar operation is followed by a discussion of the factors influencing the radar operations of target detection and parameter estimation. Transmitters, antennas, receivers, and system losses will be discussed. Propagation effects and clutter interference will be presented. Signal processing techniques will be described. Synthetic aperture radar and pulse compression techniques will also be discussed. Time permitting various applications will be described. One session per week, 3 credits. Prerequisites: 17.358, 17.376, and 92.234.



English

42.101 College Writing I

This course will be concerned with the preparation of expository and argumentative essays and with the critical reading of non-fiction; it will include a study of the techniques and documentation of research. One session per week, 3 credits. English composition requirement.

42.102 College Writing II

This course will be concerned with written and classroom work that reinforces the substance of 42.101. Imaginative literature representative of the major types will be studied as a basis for further developing competence in writing. One session per week, 3 credits. English composition requirement.

Note: Before enrolling in any English course numbered 42.224 or higher, students must complete 42.101, 42.102 to fulfill the University requirement of 6 hours in composition.

42.201 Great Books of Antiquity

Representative literary selections from the Bible, classical Greece and imperial Rome are studied as embodiments of ancient views of life and reality. One session per week, 3 credits. Area II core course.

42.202 Great Books of the Modern Period

Representative literary selections from the period of the Enlightenment to the present are studied as embodiments of modern views of life and reality. One session per week, 3 credits. Area II core course.

42.205 Human Values in Western Culture I

A close study of representative literary, philosophical, and religious texts from ancient times to the present, and relevant modern works in the behavioral and political sciences. In the first semester, the students explore and evaluate three perennial themes: the problem of evil, self and society, freedom and fate. One session per week, 3 credits. Human Values core course.

42.206 Human Values in Western Culture II

A continuation of 42.205. May be taken independently. Themes to be explored include the pursuit of knowledge, the nature of mankind, and experience of love. One session per week, 3 credits. Human Values core course.

42.212 The Short Story

A study of the development of the genre. One session per week, 3 credits. Area II core course.

42.215 The Modern Essay

A study of the essay as the literature of ideas. Concentration in twentieth century writers with attention to early examples of the genre. One session per week, 3 credits. Prerequisites: 42.101, 42.102.

42.216 The Short Novel

A study of nineteenth and twentieth century short novels as a literary genre. One session per week, 3 credits. Prerequisites: 42.101, 42.102.

42.217 The Horror Story

A study of the genre from Poe to the present. One session per week, 3 credits. Area II core course.

42.224 Business Writing

A study of the theory and practice of letters, memoranda, and reports on specific business and technical problems. Registration preference for students enrolled in Business and Management programs. One Session per week, 3 credits. (May not also take 42.226.)

42.226 Technical and Scientific Communication

A study of the theory and practice of letters, memoranda, reports, and oral presentations on specific scientific and technical problems. One session per week, 3 credits. (May not also take 42.224)

42.230 Elements of Film

A study of the elements of film as revealed in selected film classics with emphasis on analysis and evaluation. One session per week, 3 credits.

42.240 Literature and Women

A survey of literary attitudes towards women from the Judaic and Hellenic periods through the contemporary. One session per week, 3 credits.

42.241 Women in Film

A survey of the image of women in commercial film from the beginnings to the present with emphasis upon the films of the 1930's and 40's and the 1970's and 80's. Several commercial

viewings will be scheduled. One session per week, 3 credits.

42.242 The Heroine in Modern Fiction

A study of selected short stories and novels which deal sympathetically with the changing roles of women. One session per week, 3 credits.

42.246 The Rogue in Fiction

A study of the picaresque hero depicted by such writers as Cervantes, Defoe, Fielding, Cary, Donleavy, and Bellow, including attention to theories of comedy. One session per week, 3 credits.

42.250 The Bible as Literature

A literary and historical analysis of selected Old and New Testament books. One session per week, 3 credits.

42.267 Introduction to Shakespeare

A study of selected histories, comedies, and tragedies. One session per week, 3 credits. Area II core course.

42.291 History of English Literature I

A study of the historical development of English literature from the beginnings to Milton. Selected works by authors from each period are studied. One session per week, 3 credits. Area II core course.

42.292 History of English Literature II

A study of the historical development of English literature from Dryden to the beginning of the twentieth century. One session per week, 3 credits. Area II core course.

42.294 History of American Literature I

A study of the historical development of American literature from the Colonial period to the Civil War. Selected works by representative authors from each period are studied. One session per week, 3 credits. Area II core course.

42.295 History of American Literature II

A study of the historical development of American literature from the Civil War to World War I. One session per week, 3 credits. Area II core course.

42.296 History of American Literature III

A study of twentieth century American short stories, novels, poetry and drama. One session per week, 3 credits.

42.306 Professional Writing

An introduction to writing for business, government, and the professions. Topics include copywriting and editing, resumes, memoranda, letters, instructions, reports and proposals. One session per week, 3 credits.

42.317 British Literature of the Twentieth Century

A study of British short stories, novels, poetry, and drama. One session per week, 3 credits. Area II core course.

42.362 Modern Drama

A study of selected continental, British, and American plays of the late nineteenth century to the present. One session per week, 3 credits.



Geology

89.101 General Geology I

A study of the earth with emphasis on earth materials, earth structure (crustal and internal), earthy history and the development of life. Gives the general student an understanding of the dynamic earth and provides a foundation for advanced work. One session per week, 3 credits. Corequisite: 89.103. Area III Science lecture core course.

89.102 General Geology II

A continuation of 89.101 with emphasis on the surface of the earth and landform development. Includes special topics, introducing the student to recent geological research and applied geological knowledge. Designed for the general and continuing student. One session per week, 3 credits. Prerequisite: 89.101. Corequisite: 89.104. Area III Science lecture core course.

89.103 General Geology Laboratory I

Corequisite: 89.101. Must be taken with 89.101 for Laboratory Science Area III lab requirement.

89.104 General Geology Laboratory II

Corequisite: 89.102. Must be taken with 89.102 for Laboratory Science Area III lab requirement.

History

43.105 Western Civilization

Traces the major forces in the development of European history from the fall of the Roman Empire to 1715. One session per week, 3 credits. Area I core course.

43.106 The Modern World

Examines the major forces in the development of modern European history from the French Revolution to the present. One session per week, 3 credits. Area I core course.

43.111 United States History to 1877

Traces the development of American history and institutions from the colonization to the end of Reconstruction (not open to history concentrators). One session per week, 3 credits. Area I core course.

43.112 United States History Since 1877

Examines significant developments in American history from the end of the Reconstruction period to the Present (not open to history concentrators). Area I core course.

43.205 Ancient American Civilization

A study of the peoples and civilizations of the Americas from their origins to first contact with Europeans. One session per week, 3 credits.

43.228 The American Indian

A study of native Americans from their first contact with Europeans to the present, with special emphasis on North American Indians and their relationship with the United States government. One session per week, 3 credits.

43.237 American Environmental History

Attitudes, policies, and behavior of Americans and their government toward the environment. Special attention to current issues evolving out of our past attitudes and policies. One session per week, 3 credits.

43.239 American Economic History

A study of the growth and development of the American economy from its European origins to the present. One session per week, 3 credits. Area I core course.

43.277 Ethnic Groups in American Life

An examination of the importance of ethnic groups in American history. The course will treat several major ethnic groups and assimilation or non-assimilation into American life. Field work and research on ethnic groups in the Merrimack Valley. One session per week, 3 credits.

Industrial Technology

20.105 Introduction to Engineering Design

A course to introduce students to industrial practice in design graphics. Topics include graphs, orthographic projection, sectioning, limit dimensioning, gear trains, cams and fasteners. One four-period session per week (2 lecture: 2 lab), 3 credits.

20.112 Machine Tool Processes

An introduction to fundamental machine shop techniques covering machining practice, measurement and layout, and general shop safety. The objective is to develop an appreciation for basic machine tool practices utilized in manufacturing and knowledge of process and tooling specification for operations planning. Practical exposure enhances ability to communicate concepts regarding maintenance, prototype and production projects. One four-period session per week (2 lecture: 2 Lab), 3 credits. Prerequisite: 20.105 or equivalent. Note: replaces 23.201.

20.152 Water Biology

An introduction to the biology of natural waters. Topics include freshwater animals, plants, community relationships, population dynamics, effect of pollution, water borne disease. Includes some lab and field work. One session per week, 3 credits.

20.153 Aquatic Ecology

A study of the principles and concepts involved in marine and fresh water ecology. This course will explore biogeochemical cycles, population dynamics and water pollution. Field trips are planned to a fresh water stream or pond and to a local marine tidal zone, where a collection and indentifications of various organisms will be made. Practical lab work with relevance to ecology is also planned. One session per week, 3 credits. Prerequisite: 20.152.

20.201 Introduction to Materials

A practical study of the relationship between properties, composition and structure of metals, ceramics and composites. This course includes selection, crystal structure, alloy phase diagrams, solidification and heat treating principles of metals as well as their application in normal and extreme environmental conditions. Laboratory (20.211) investigations reinforce lecture material

but emphasize testing procedures for materials. One session per week, 3 credits. Prerequisite: 84.111.

20.202 Industrial Computer Science

An introduction to the use of computers in industry by programming COBOL and FORTRAN languages. Ten programs are required to be designed and run by the students. Problems include I/O, min-max, branching, arrays, matrices, plotting, subprograms, and major inventory type problems. One session per week, 3 credits.

Note: This may be taken in lieu of both Basic (or COBOL) and FORTRAN requirements of earlier programs. A technical elective will then be required to make up difference in credits.

20.211 Industrial Materials Laboratory

Laboratory studies designed to accompany Introduction to Materials and Advanced Materials. One session per week, 1 credit. Prerequisite: or Corequisite: 20.201, 20.208.

20.225 Water Chemistry I

This course covers basic chemical theory. Reactions and equations will be presented along with an introduction to the structure and character of water, its impurities and the chemical treatment schemes that have been devised to deal with them. One session per week, 3 credits.

20.226 Water Chemistry II

A continuation of 20.225, it covers specific water and wastewater treatment practices, such as chlorination, coagulation, filtration, and absorption, with a focus on analytical techniques for the particular parameters of interest. Wet chemistry as well as instrument methods will be discussed and demonstrated during lab sessions that complement the lecture material. One session per week, 3 credits. Prerequisite: 20.225.

20.251 Wastewater Treatment Plant Operations I

This course is geared to the assumption that students are not familiar with plant operations. Lectures begin on preliminary treatment and proceed through primary and various types of secondary treatment with emphasis on activated sludge, chlorination, and sludge dewatering and

ultimate disposal. The primary emphasis is on the conventional activated sludge process. One session per week, 3 credits.

20.252 Wastewater Treatment Plant Operations II

This course is available for those who have taken 20.251 or for plant operators experienced in biological treatment. Control of the activated sludge process is emphasized, based upon solids balancing, using the centrifuge and settleometer. This technique has been developed by AI West of EPA. In addition, industrial wastes and advanced wastewater treatment are covered, including the removal of phosphates and nitrates. One session per week, 3 credits. Prerequisite: 20.251.

20.253 Wastewater Treatment Lab I

An introductory course teaching the basic laboratory techniques and procedures used to operate and monitor conventional wastewater treatment facilities. Included are solids, chlorine residual, pH, BOD, total coliform, alkalinity, acidity, sludge, and microscope analysis. One session per week, 1 credit. Corequisite: 20.251.

20.254 Wastewater Treatment Lab II

An advanced course designed to teach the lab techniques and procedures used to operate and monitor advanced wastewater treatment facilities. Included are "West" method, nitrification, phosphorous, jar test, CODD, BOD, TOC, total coliform, turbidity, and chloride analysis. One session per week, 1 credit. Prerequisites: 20.251, 20.253.

20.255 Water Distribution Systems

This course is an introduction to the principles, materials and practices in the operation and maintenance of drinking water distribution systems, including the following topics: system hydraulics, pumping, mains, services, valves, hydrants, metering, flushing, storage, fire control, leak control, cross connection prevention, disinfection, etc. One session per week, 3 credits.

20.257 Water/Wastewater Plant Management I

An introduction to the principles of management with emphasis on topics related to the operation of water and wastewater treatment plants. The following subjects will be discussed: staffing,

labor relations, public relations, financing, budgeting, legislation, and management principles. One session per week, 3 credits.

20.258 Water/Wastewater Plant Management II

A continuation of 20.257, Water/Wastewater Plant Management I, with an emphasis on supervisory management for water and wastewater personnel. Rate studies, user services, labor relations, and numerous case studies will be utilized. One session per week, 3 credits. Prerequisite: 20.257.

20.303 Mechanical Systems

An introduction to the design or selection of mechanical elements used in the transmission of power in industrial equipment. Elements considered include shafts, pulleys, gears, and gear trains, bearings, clutches, brakes and springs. One four-hour session per week (2 lecture: 2 lab), 3 credits. Prerequisite: 23.221 or equivalent.

20.305 Manufacturing Processes

Course work entails introduction to nonconventional machining, such as Electrical Discharge Machining, and the various forms of chemical machining; automatic manufacturing concepts from electromechanical operations to the fundamentals of numerical control manufacturing, forming, casting, fastening and assembly techniques are also covered. The object is to develop a broader understanding of manufacturing operations and product design/manufacturing relationships. Laboratory experience includes nonconventional machining, numerical control operations and programming. One four-period session per week (2 lecture: 2 lab), 3 credits. Prerequisites: 20.105, 20.107, 23.201.

20.307 Fluid Power Controls

The elements of hydraulic and pneumatic power systems and their control; elements such as cylinders and valves are studied in detail and combined to form complete circuits coupled with relay and pneumatic control. One four-hour session per week (2 lecture: 2 lab), 3 credits. Prerequisite: 23.221.

20.309 Process Measurement and Control

An introduction to process control system technology. Liquid level, rate of flow, pressure and temperature measuring devices and their

characteristics. R-C of system components. Integral, dead-time and first order lag processes. Control modes. Bode diagrams and frequency response. One three-hour session per week (1 lecture: 2 lab), 2 credits. Prerequisite: 17.127.

20.310 Industrial Safety

A practical study of industrial safety and accident prevention. Studies include hazard analysis, safety management, engineering remedies and risk management. Numerous practical cases are presented and the roles of governmental agencies in safety are analyzed. One session per week, 3 credits.

20.314 Motion and Time Study

Methods improvement and work measurement techniques, including principles of motion economy, work simplification, process and operator charts, work sampling and time standard. One session per week, 3 credits.

20.351 Water Supply and Treatment Operations I - Basic

An introduction to the principles and practices of operation and maintenance of drinking water supplies and treatment plants. The following topics will be covered using case studies: sources of supply, well and reservoir operation, contaminants and regulation, hazardous materials, overview of treatment, chemical feeding, coagulation, settling, operating conditions, filtration, solids handling, disinfection, chlorination, fluoridation. One session per week, 3 credits.

20.352 Water Supply and Treatment Operations II - Advanced

A continuation of 20.351. Water Supply and Treatment Operations I, covering the following topics: corrosion control, oxidation and aeration, use of ozone, chlorine dioxide and potassium permanganate, iron and manganese carbon, softening, instrumentation and control, system contamination control, reverse osmosis, ultrafiltration, electrodialysis, distillation and UV, energy management. One session per week, 3 credits. Prerequisite: 20.351.

20.353 Water Works Operation Lab I

This laboratory course will introduce the student to fundamental laboratory equipment as it applies to the operation of water treatment facilities. The following determinations will be

conducted: odor, test, color, turbidity, jar tests, pH, chlorine residual, acidity, alkalinity, hardness, chlorides, iron, manganese, phosphate, aluminum, nitrogen, cycle, coliform, microscopic analysis, heavy metals and organics. One session per week, 1 credit.

20.354 Industrial Waste Treatment

An introductory approach to the operation and control of the major types of industrial waste treatment processes. The industrial waste treatments to be discussed include the following industries: textile, food processing, paper, metal finishing, and tanneries. This course will include basic labor work to include pH, alkalinity, acidity, chlorine residual, and solids. One session per week, 3 credits.

20.355 Water Works Operations Lab II

This course presents a continuation from the material in 20.253. The following determinations will be conducted: fluoride, fecal, coliform, phosphate, algae and microscopic analyses, filterability, TKN, TOC, heavy metals with AA apparatus, activated carbon assessment, and laboratory quality assurance. One session per week, 1 credit. Prerequisite: 20.353.

20.356 Hazardous Waste Management

This three-credit course will address the current topic of hazardous waste management in an interdisciplinary manner. Topics covered will include hazardous waste regulations, regulatory agency functions, industrial hazardous waste management systems (contingency plans, closure plans, spill control plans, etc.), treatment, storage and disposal techniques (present and future), facility siting, source reduction techniques and right to know legislation. The emphasis will be on presenting a wide range of information that will encourage the student to think innovatively and develop an understanding of why it is imperative that all hazardous wastes are managed in an environmentally sound manner. This course is written for the college-level student in such programs as civil/sanitary engineering, industrial technology or chemical engineering. The course will also be of value to any industrial or municipal worker who has hazardous waste management as part of their job responsibility. One session per week, 3 credits.

20.357 Physical/Chemical Treatment of Industrial Wastewater I

This course covers the operation of physical/chemical processes normally used in treating wastewater from metal plating, such as: chemical feed systems; flow equalization; neutralization; precipitation; clarification; oxidation; reduction and sludge dewatering. It also covers operation and maintenance of mechanical equipment and instrumentation. One session per week, 3 credits.

20.358 Physical/Chemical Treatment of Industrial Wastewater II

This covers the operation of physical/chemical treatment processes used to treat industrial wastewaters other than simple metal finishing wastes. The processes include: chelated metal reduction; coagulation; flotation; filtration; carbon absorption; reverse osmosis; ultrafiltration; electrolytic recovery; ion exchange; evaporation; oil removal and source reduction. Economic comparisons of treatment processes are also discussed. One session per week, 3 credits. Prerequisite: 20.357.

20.402 Manufacturing Operations

This course is organized so that students can design the manufacturing process and fabricate a product for small quantity production. Accompanying lectures cover pertinent subject areas such as: forecasting, plant layout, materials handling, pert/cost, product evaluation and equipment selection, 3 credits. Prerequisite: 17.130.

20.406 Energy Conversion Technology

An introduction to the laws and concepts of thermodynamics; the first and second laws, properties of liquids and gases, common power cycles. Included is an overview of the energy problem and power generation technologies, both established and novel. One session per week, 3 credits. Prerequisites: 23.221, 92.126, 99.131.

20.408 Microprocessors

A continuation of 20.309 Process Measurement and Control with emphasis on the use of microprocessors in programmable controllers. A laboratory supplements the theory. One three-hour session per week (1 lecture: 2 lab), 2 credits. Prerequisite: 20.309.

20.414 Industrial Economic Management

Analysis of available alternatives in equipment, plant and materials purchasing or leasing. Economic feasibility analysis of industrial projects including depreciation techniques, break-even analysis, benefit-cost techniques, replacement, present worth and rate of return analysis. One session per week, 3 credits.

20.416 Statistical Quality Control

A study of traditional and current statistical techniques applied to solutions of quality problems, quality maintenance and quality improvement activities. The producer/consumer roles, inherent in every process involving production of quality goods or services, will be emphasized in the development of each of the techniques, which include statistical evaluation, process capability, control charts, sampling plans, correlation, regression analysis and optimization. One session per week, 3 credits. Prerequisites: 20.112, 92.386, or their equivalents.

20.423 Product Liability

Product liability has become of increasing importance to industrial engineers due to legal decisions involving direct placement of liability for safe products on original manufacturers and on individual responsible engineers. In this course, the legal aspects of negligence, strict and implied liability will be developed and the role of engineers in designing, manufacturing and testing reasonable, safe products will be defined. The role of government agencies such as the Consumer Product Safety Commission and reference sources for product liability literature will be examined. Numerous product liability cases will be reviewed with specific examples of investigative techniques utilized to prove liability for failure. One session per week, 3 credits.

20.427 Plant Layout and Materials Handling

A study of materials flow, layout production, assembly and service departments, manufacturing, buildings, service facilities, handling equipment, and packaging techniques. One session per week, 3 credits. Prerequisites: 20.105, 20.107.

20.429 Occupational Safety and Health Regulations and Regulatory Agencies

An introduction to the general concepts of safety and health. Topics include historical developments, program concepts, social, legislative and

regulatory requirements and basics of hazard recognition, evaluation and control. The role of governmental agencies, such as OSHA, EPA, and NIOSH, in safety will be explored. In addition to course credits, a certificate will be issued from OSHA upon completion. One session per week, 3 credits.

20.430 Industrial Hygiene and Toxicology

An introduction to the principles of industrial hygiene and toxicology. Topics include elements of toxicology and occupational disease, airborne contaminants, ionizing and non-ionizing radiation, noise and vibration, and heat stress. Emphasis on understanding biological response to and measurement of environmental hazards. Application of non-engineering controls with some introduction to the concepts of engineering controls. One session per week, 3 credits. Prerequisite: 20.429.

20.431 Safety Management

Application of management principles to loss control programs. Topics include organization of the safety function, program evaluation techniques, budgeting for safety function, evaluation of training and education programs, emergency planning, relationships with line and staff functions, the legal environment of safety and health, and loss control accountability. One session per week, 3 credits. Prerequisites: 69.371, 20.429.

20.432 Fire Prevention and Protection

Introduction to fire prevention and protection; behavior of fire, fire hazards of materials, fire safety in facilities and equipment of design, design of fire protection systems and detection systems, process fire hazards, transportation fire hazards, and fire codes. One session per week, 3 credits. Prerequisites: 20.310, 20.429.

20.433 Human Factors in Engineering Design

An examination of the variables that influence the human operator in man-machine-environment systems. Topics include the nature of man-machine systems, the capabilities and limitations of humans and machines, simulation for design and training, principles of symbolic and pictorial displays, static and dynamic forces on the human frame, response to environmental stress, and vigilance and fatigue. One session per week, 3 credits. Prerequisites: 47.101, 23.221, 92.383.

20.452 Operation and Maintenance of Wastewater Collection Systems I

This course will examine the proper operation and maintenance of wastewater collection systems. Inspection, testing, installation, and repairs of the collection system will be covered. Health hazards encountered in this work will be addressed and safety will be emphasized. Pumping station operation and maintenance will be covered in detail. Confined space entry and working in hazardous environments is covered. One session per week, 3 credits.

20.453 Operation and Maintenance of Wastewater Collection Systems II

Locating and evaluating problems such as sewer blocks, leaks, odors, breaks and lift station failures. The selection of procedures and equipment to minimize the reoccurrence of these problems will be addressed. Cost effectiveness of purchasing versus leasing construction equipment for major work will be discussed. Organization, administration and union involvement in the field will be covered. State-of-the-art construction and design will be covered with a field trip to a modern pumping facility. One session per week, 3 credits. Prerequisite: 20.452.

20.455 Solid Waste Management

An introduction to the principles and practices of solid waste management with emphasis on the sources and characteristics of present day solid wastes; current collection methods, system and equipment; available disposal techniques and facilities; public health, economic and environmental issues; future trends in the solid waste industry. One session per week, 3 credits.

20.457 Advanced Water and Wastewater Laboratory

Includes some of the most modern instrumental techniques for water and wastewater analysis, including A.A., TOC, and gas chromatography. Also includes laboratory quality control with special emphasis on laboratory certification. One session per week, 1 credit. Prerequisites: 20.253, 20.254.

Interdisciplinary Courses

59.203 Technology and Human Values I

This is a team-taught course about the interrelationship of technology and human values. It begins with an exploration of the industrial revolution in Lowell, followed by an examination of topics drawn from areas such as agriculture, third world development, population control, energy and natural resources, household technology, and transportation. Unifying themes are the values associated with science and technology, the role and responsibility of the scientist and technologist, and the question of whether scientific and technological development should be and can be controlled. 3 credits. Human Values core course.

59.204 Technology and Human Values II

A continuation of 59.203. 3 credits. Human Values core course.

59.205 Human Values in Western Culture I

This course is designed to address some of the important questions of human existence through a close study of representative literary, philosophical, and religious texts from ancient times to the present, and relevant modern works in the behavioral and political sciences. In the first semester, the students explore and evaluate three perennial themes: the problem of evil, self and

society, freedom and fate. In the second semester course, the thematic units are the pursuit of knowledge, the nature of humankind, and the experience of love. 3 credits. Area II core course.

59.206 Human Values in Western Culture II

A continuation of 59.205. May be taken independently of 59.205. 3 credits. Area II core course.

59.214 Nuclear Weapons, Values and Society

An examination of popular values and conceptions concerning nuclear weapons and of the political, diplomatic and economic issues surrounding those weapons. An analysis of the strategic and political interests of the major powers and of alternatives to the nuclear arms race. 3 credits. Human Values core course.

59.215 Computers in Society

An exploration of the relationship between computers and the society in which they operate: the nature of computers and their historical development; possibilities and problems arising from computer use in such areas of contemporary life as education, the military, and business; the issues of freedom vs. control of the individual. 3 credits. Human Values core course.



Languages

50.101 Beginning French I*

Development of fundamental skills in oral expression, aural comprehension, reading and writing. Tapes available for laboratory use. Students who have completed more than one year of French at the secondary level are ineligible for this course. One session per week, 3 credits.

50.102 Beginning French II*

A continuation of 50.101, which is a prerequisite. One session per week, 3 credits.

50.211 Intermediate Conversational French I*

Review of basic grammatical structures and idiomatic patterns with emphasis upon increased proficiency in oral expression and aural comprehension. Intended for students who have completed two years of high school French, preferably during their junior and senior years, for students who have completed 50.102. One session per week, 3 credits. Area II core course.

50.212 Intermediate Conversational French II*

A continuation of 50.211, which is a prerequisite, with emphasis upon continued development of comprehension and conversational skills. One session per week, 3 credits. Area II core course.

51.101 Beginning German I*

Development of fundamental skills in oral expression, aural comprehension, reading, and writing. Tapes available for laboratory use. Students who have completed more than 1 year of German at the secondary level are ineligible for this course. One session per week, 3 credits.

51.102 Beginning German II*

A continuation of 51.101, which is a prerequisite. One session per week, 3 credits.

54.101 Beginning Spanish I*

Development of fundamental skills in oral expression, aural comprehension, reading, and writing. Tapes available for laboratory use. Students who have completed more than one year of Spanish at the secondary level are ineligible for this course. One session per week, 3 credits.

54.102 Beginning Spanish II*

A continuation of 54.101, which is a prerequisite. One session per week, 3 credits.

54.211 Intermediate Conversational Spanish I*

A review of Spanish grammar and syntax with emphasis upon increased proficiency in aural comprehension and oral expression. This course is intended for students who have completed two years of high school Spanish, preferably during their junior and senior years, for students who have completed 54.102. One session per week, 3 credits. Area II core course.

54.212 Intermediate Conversational Spanish II*

A continuation of 54.211, which is a prerequisite, with emphasis upon continued development of comprehension and conversational skills. One session per week, 3 credits. Area II core course.

54.245 Advanced Spanish Conversation

Advanced oral fluency in rapid and idiomatic speech. Topics of contemporary significance will be selected from contemporary prose. One session per week, 3 credits.

54.254 Topics in Conversational Spanish

Discussion of a wide spectrum of contemporary topics with the object of continuing to develop facility and accuracy of expression. Prerequisite: advanced level proficiency. One session per week, 3 credits.

**Beginning and intermediate courses at the 101-102 and 211-212 levels must be elected for two consecutive semesters and in the prescribed sequence. College credit may not be granted for one semester of such courses unless exception is permitted by the Chairperson of the Department of Languages on the basis of student placement in a more advanced language course.*

Management

69.201 Principles of Management

Introduction to the principles of management, including the functions of planning, directing, organizing, and control in relation to business. One session per week, 3 credits.

69.321 Marketing Principles

Product planning, distribution, promotion and pricing studied in the context of consumer behavior, governmental constraints and the structure of business institutions. One session per week, 3 credits. Prerequisite: 68.201.

69.331 Business Finance

Principles of financial management, including working and fixed capital sources of funds, financial statements, budgeting and capitalization. One session per week, 3 credits. Prerequisites: 67.202, 68.201, 68.202.

69.332 Money and Banking

Evolution of money and credit and their role in the economy. Monetary policy and the Federal Reserve System. Structure and function of the Principles of sales force organization, selection, training, compensation, supervision and motivation are explored via appropriate cases. One session per week, 3 credits. Prerequisite: 69.321.

69.353 Organizational Behavior

Applications of concepts from the behavioral sciences to individual and group activity in organizations. Use of behavioral concepts to introduce and implement organizational change. One session per week, 3 credits. Prerequisites: 47.101, 48.101.

69.371 Operations Management

Principle of production/operations management. Nature and function of production systems; operation planning and control; plant layout; materials handling; inventory and quality control. One session per week, 3 credits. Prerequisite: 90.241.

69.417 Real Estate

The study of evaluation, legal, financial, and regulatory aspects of real estate management. One session per week, 3 credits.

69.426 Sales Management

Management of the personal selling function. Principles of sales force organization, selection, training, compensation, supervision and motivation. One session per week, 3 credits.

69.434 Investment Management

Principles of investment: security analysis, portfolio management, market analysis. One session per week, 3 credits. Prerequisite: 69.331.

69.451 Personnel Management

Recruitment, selection and training of the work force. Wage and salary administration, employee health and safety, welfare and education. One session per week, 3 credits. Prerequisite: 69.201.

90.241 Statistics for Business I

Descriptive statistics, sophisticated counting techniques and other components of probability, simple random variables and their distributions, bivariate functions, sampling theory, properties of estimators, confidence intervals, and hypothesis testing. One session per week, 3 credits. Prerequisite: 90.112 or 90.113. May not also take 92.383.

90.242 Statistics for Business II

Analysis of variance, applied regression theory, correlation analysis, and other selected topics. One session per week, 3 credits. Prerequisite: 90.241. May not also take 92.383.



Mathematics

All mathematics courses, including those designated as Computer Mathematics Option courses except 90.010 and 90.111 are transferable to the University of Lowell day division upon appropriate University approval. Courses with the prefix 92 are equivalent to those in the day school with the same number. Day school students wishing to elect courses with the prefix 90 must consult the Chairperson and/or Coordinator in order to determine course equivalence.

Please note that the number of all course contact hours equals the number of course credits.

90.010 Introductory Mathematics

A transitional course designed for students with a limited mathematics background. The main purpose of this course is to give students an insight into the structure of basic mathematics, including algebra, and to increase the students' manipulative skills in this area. One session per week, 3 credits.

90.111 Fundamentals of Algebra

This course is intended for students with little or no background in basic algebra or whose background is not current. Topics covered include: the real number system, factoring fractions, linear equations, functions, graphs, systems of equations and the quadratic equation. One session per week, 3 credits.

**Please note that students may not use 90.010 and 90.111 as electives in any degree programs.*

90.112 Concepts in Algebra I

This course is intended for students whose background in basic algebra is current. The emphasis is on applications to the management and the social sciences. Topics covered include: an introduction to set notation, equations, inequalities, functions and matrices. Credit is not given for both 90.112 and 90.113. One session per week, 3 credits. Prerequisite: 90.111 or satisfactory score on the Math Placement exam given the first week of class.

90.113 College Algebra

This course is intended for students whose background in basic algebra is current. The course objective is to provide students with the problem solving and computational techniques needed for further coursework and in their occupation. Topics include: quadratic equations, functions, transformations, inequalities, systems of equations and exponential and logarithmic functions. Credit not given for both 90.112 and 90.113. One session per week, 3 credits. Prerequisite: 90.111 or satisfactory score on the Math Placement exam given first week of class.

90.119 Concepts in Algebra II

Continuation of 90.112. Topics include quadratic functions, the mathematics of finance, linear programming, optimization and an introduction to differential calculus. One session per week, 3 credits. Prerequisite: 90.112

92.115 College Trigonometry

Angles and their measure, the trigonometric functions, solving triangles, law of sines, law of cosines, circular functions and their graphs, trigonometric identities. One session per week, 3 credits. Prerequisite: 90.113

92.125 Calculus A

A first course in calculus dealing with a brief review of analytic geometry and trigonometry. Progresses to the study of limits, derivatives, rules for differentiation of algebraic and transcendental function; chain rule, implicit differentiation, continuity, related rate problems, max. min problems, and curve sketching. One session per week, 3 credits. Prerequisite: 92.115.

92.126 Calculus B

A continuation of Calculus A. The course covers integration, rectilinear motion, sigma notation, area, area between two curves, volumes by disc and shell methods, length of a plane curve and surface area, natural logarithm, the exponential function, hyperbolic functions, inverse functions and inverse trigonometric functions, integrals and derivatives of the inverse trig. functions, and integration formulas. One session per week, 3 credits. Prerequisite: 92.125. Corequisite: 15.237.

92.221 Linear Algebra I

An introduction to sets and mathematical logic. The basic properties of linear mappings, matrices, scalar products and orthogonality, systems of linear equations. Applications of the above. One session per week, 3 credits. Prerequisite: 92.225 or permission of Coordinator.

92.222 Linear Algebra II

Matrices and bilinear forms; symmetric, hermitian and unitary operators, eigenvectors and eigenvalues; the Caley Hamilton, Sylvester and Spectral Theorems. Applications of the above. One session per week, 3 credits. Prerequisite: 92.221.

92.223 Survey of Calculus

A survey of the basic concepts in differential and integral calculus. Topics included are: techniques of differentiation and integration and applications. This is a one semester course intended to provide a broad appreciation of the topics ordinarily covered in the first two semesters of a calculus course. This course may not be used to replace any required calculus course. One session per week, 3 credits. Prerequisite: 90.113.

92.225 Calculus C

A continuation of Calculus B. This course covers integration by parts, integration of trigonometric integrals, trigonometric substitution, partial fraction, numeric integration, improper integrals, L'Hopital's Rule, indeterminate forms, sequences, infinite series, integral test, comparison tests, alternating series tests, power series, Taylor series, polar coordinates, graphs and areas in polar coordinates, and parametric equations. One session per week, 3 credits. Prerequisite: 92.126.

92.226 Calculus D

A continuation of Calculus C. This course covers vector calculus, curvature, cylindrical surfaces, dot and cross products, curves and planes in three space, cylindrical and spherical coordinates, functions of two variables, chain rule, directional derivatives and gradient, tangent planes and functions of n variables, a double and triple integrals in rectangular, polar, cylindrical and spherical coordinate systems. One session per week, 3 credits. Prerequisite: 92.225.

90.241 Statistics for Business I

Descriptive statistics, sophisticated counting techniques and other components of probability, simple random variables and their distributions, bivariate functions, sampling theory, properties of estimators, confidence intervals, and hypothesis testing. One session per week, 3 credits. Prerequisite: 90.112 or 90.113. May not also take 92.383.

90.242 Statistics for Business II

Analysis of variance, applied regression theory, correlation analysis, and other selected topics. One session per week, 3 credits. Prerequisite: 90.241. May not also take 92.383.

92.234 Differential Equations

A course in ordinary differential equations including equations of order one, linear differential equations, non-homogeneous equations, method of undetermined coefficients, the Laplace transform, systems of equations, electric circuits and network, existence and uniqueness of solutions, and nonlinear equations. One session per week, 3 credits. Prerequisite: 92.225.

92.301 Introduction to Applied Mathematics I

Matrices. Vector analysis, review of vector algebra, vector calculus, divergence theorem. Green's theorem and Stokes' theorem. One session per week, 3 credits. Prerequisite: 92.226

92.302 Introduction to Applied Mathematics II

Series solutions of ordinary differential equations. Bessel functions, Legendre functions. Ordinary differential equations, boundary value problems. Fourier series and integrals. Partial differential equations of physics and engineering, separation of variables. One session per week, 3 credits. Prerequisite: 92.234.

92.305 Introduction to Real Analysis I

Some set theory including equivalence and countability. An axiomatic introduction to the real number system. Sequences of real numbers including boundedness, monotonicity, convergence, divergence. Series of real numbers including convergence, divergence, absolute convergence. Limits and continuity of real functions of a real variable. Metric spaces

including open sets, closed sets, limits of sequences, limits and continuity of functions, connected sets, compact sets, bounded sets, total bounded sets, completeness, continuous functions on compact sets, the Intermediate Value Theorem, uniform continuity. One session per week, 3 credits. Prerequisites: 90.221, 92.225.

92.306 Introduction to Real Analysis II

The calculus of Newton and Leibnitz including the Riemann integral, averages of a function, the derivative, the Fundamental Theorems of Calculus, the Mean Value Theorem. Sequences and series of real valued functions of a real variable including pointwise convergence, uniform convergence, integration and differentiation. The Weierstrass Approximation Theorem and the Stone-Weierstrass Approximation Theorem and the Stone-Weierstrass Theorem. Lebesgue measure including measurable sets, nonmeasurable sets, measurable functions. The Lebesgue integral including the Lebesgue Dominated Convergence Theorem, Fatou's Lemma, and the metric space $L_2[a,b]$. One session per week, 3 credits. Prerequisite: 92.305.

92.307 Probability and Mathematical Statistics I

Probability functions and densities, expectations. Moments of probability distributions. Central Limit Theorem. One session per week, 3 credits. Prerequisite: 92.226

92.308 Probability and Mathematical Statistics II

Sampling, decision theory, estimation, hypothesis testing, regression and correlation. One session per week, 3 credits. Prerequisite: 92.307.

92.315 Partial Differential Equations I

Basic concepts in partial differentiation. Classifications and solution of first order and higher order linear partial differential equations. Introduction to Bessel, Legendre, and other orthogonal functions. Boundary value problems included application of Fourier Series, Fourier Integrals, and Laplace Transforms. One session per week, 3 credits. Prerequisite: 92.234.

92.321 Discrete Structures I

Propositional logic, connectives, rules of inference, quantifiers. Proofs, proof by contradiction, induction, applications in computer logic and proofs of program correctness. Algebra of

sets, relations on sets, equivalence relations, functions, composition, one-to-one, onto, orderings, applications to data structures and topological sorting. Matrices, solution sets for systems of matrix operations, eigenvalues and eigenvectors, diagonalization and Jordan canonical form. One session per week, 3 credits. Prerequisite: 90.112 or 90.113 or equivalent.

92.322 Discrete Structures II

Algebraic structures, sets with operations, associative, commutative, and distributive operations, modular arithmetic, electronic privacy and signature. Groups and semigroups, group axioms, permutation groups, cosets, normal subgroups, sequential machines. Directed and undirected graphs, paths, circuits, reachability and connectedness, decision trees, balanced trees, polish notation and trees, graphs scheduling problems, flow in network, data structures. Lattices and Boolean Algebra, switching theory, logic design. Finite fields, representation and structure, minimal and irreducible polynomials, primitive elements, polynomial roots, error-correcting codes, public security key systems. One session per week, 3 credits. Prerequisite: 92.321.

92.362 Numerical Analysis I

Theory and applications of numerical techniques including: error analysis, non-linear systems of equations, matrices, eigenvalues, interpolation and collocation of polynomials, numerical integration. Computer solutions are emphasized. One session per week, 3 credits. Prerequisites: 92.263, 92.225.

92.364 Problem Solving with Pascal

This course is designed to be a practical problem solving course, to give students further exposure to the topics covered in 92.265, and to provide the tools needed for software development. The course emphasizes these aspects of the programming problem solving process: problem specification and organization, algorithms, coding, debugging, the elements of good programming style and the means of producing a high-quality finished product. Programming examples are chosen to span a wide range of both numeric and non-numeric applications. One session per week, 3 credits. Prerequisite: 92.265.

**92.381 Introduction to Operations
Research Techniques I**

The use of decision models in industrial systems. Fundamentals of probability and matrix theory. Critical path methods. Linear programming. The simplex method. Sensitivity analysis. Goal programming. Transportation and assignment models. Integer programming. One session per week, 3 credits. Prerequisite: 92.126.

**92.382 Introduction to Operations
Research Techniques II**

A continuation of 92.381. Topics include: inventory control models, Markov analysis, queuing models, dynamic programming, network analysis, and simulation techniques. One session per week, 3 credits. Prerequisite: 92.381.

92.383 Introduction to Statistics

Sets and probability laws, random variables, mathematical expectations, measure of central tendency and variance. Study of discrete and continuous probability distribution, sampling theory, tests of hypothesis. Regression and correlation. (May not be used to satisfy mathematics major requirements. Primarily for students who want a one-semester introduction to statistics. Students who wish a more detailed development of statistics and probability are advised to take the sequence 92.307, 92.308.) One session per week, 3 credits. May not also take 90.241, 90.242. Area III core course.

92.411 Complex Variables I

Complex numbers. Functions of a complex variable. Mappings. Derivatives. Analytic functions. Elementary functions. Integrals. Laurent series. Residues and poles. Contour integration. One session per week, 3 credits. Prerequisite: 92.226.

92.412 Complex Variables II

Transformations. Conformal mappings. Boundary conditions. Application in heat conduction, electrostatic potential, and fluid flow. Gamma and beta functions. Inverse Laplace transform. Riemann surfaces. One session per week, 3 credits. Prerequisite: 92.411.

92.421 Abstract Algebra I

Elementary group theory, groups, cosets, normal subgroups, quotient groups, isomorphisms, homomorphisms, series of groups, the Sylow

theorems, free groups and homology groups. One session per week, 3 credits. Prerequisite: 92.126.

92.422 Abstract Algebra II

Elementary ring and field theory, quotient rings and ideals, homomorphisms of rings, rings of polynomials, algebraic extensions, automorphisms of fields, separable extensions. Galois Theory. Introduction to categories and functors. One session per week, 3 credits. Prerequisite: 92.421.

92.442 Boundary Value Problems

The Fourier series as a tool of analysis. Orthogonal functions, convergence tests, the Fourier integral, partial differential equations of physics and engineering, and boundary value problems. One session per week, 3 credits. Prerequisite: 92.306.

92.454 Numerical Analysis II

Continuation of 92.362 including numerical solution of ordinary and partial differential equations, boundary value problems, curve-fitting, linear programming, error analysis and computer solutions. One session per week, 3 credits. Prerequisite: 92.362.

92.465 Formal Languages

This course will study the formal or abstract properties of (computer) languages and of acceptors/recognizers for valid expressions in the syntax of the languages. Topics to be covered will include: the Chomsky hierarchy of languages. Finite State Machines: their basic properties/results and as acceptors for Regular Expressions. Two-way acceptors and Automata. Pushdown Automata: acceptors for Context Free Languages and grammars for Pushdown Automata. Context Free Grammars. Transformations on grammars and canonical forms for grammars. Syntax Analysis: Top-down, bottom-up and precedence analysis. Parsing. Turing Machines. One session per week, 3 credits. Prerequisite: Pascal.

92.466 Theory of Computation

Models of computation. Turing machines and Turing-compatible functions. Other models of computation. The Church-Turing thesis. Universal machines. Recursive functions, primitive recursive and partial recursive functions. Simulation of various computations.

Recursive and recursively enumerable sets. Unsolvable problems: computable versus non-computable functions. Halting problems, equivalence problems, word problems, etc. Other topics as time and interest permit. One session per week, 3 credits. Prerequisite: Pascal.

92.471 Introduction to the Design and Analysis of Algorithms

Basic steps in developing an algorithm, correctness, algorithm design techniques, such as hill climbing, subgoals, heuristics, backtracking, branch and bound, recursion, sorting and searching, paging, parallelism, algorithm and program

correctness, measures of algorithm efficiency, complexity and overall effectiveness. One session per week, 3 credits. Prerequisite: permission of Coordinator.

92.498 Mathematics Seminar

Student reading, writing, and criticism of topics from current literature. Review of some important elements of undergraduate work. One session per week, 3 credits. Prerequisite: permission of Coordinator.

Mechanical Engineering Technology

23.111 Engineering Drawing I

Class and laboratory. First course in graphical communications; lectures and exercises on the presentation of data and shape description of various mechanical parts. Topics covered include orthographic projection; isometric and oblique pictorials, and sketching. One session per week, 2 credits.

23.112 Engineering Drawing II

Class and laboratory. Continuation of Drawing I. Topics covered include descriptive geometry of lines, points, and planes as well as intersections, developments, dimensioning. One session per week, 2 credits. Prerequisite: 23.111.

23.113 Machine Drawing

Class and laboratory. Drawing of a machine from detailed layout to its final assembly, including drawing of cams, gears, and fasteners. Positional and geometric tolerancing. One session per week, 2 credits. Prerequisite: 23.112.

23.202 Thermo/Fluids Laboratory

Fundamentals of measurements in the general areas of thermodynamics and fluid mechanics. Laboratory topics include flow measurement of air and steam, critical flow through an orifice, fluid flow in pipes and pumps, tests of heat exchangers, gas turbines, internal-combustion engines, and refrigeration cycles. One session per week, 2 credits. Prerequisites: 23.241, 23.242, 42.226.

23.221 Statics

The fundamentals of statics. Topics covered include vector algebra, force, resultants, moment of a force, friction, area and mass moment of inertia, and static equilibrium of rigid bodies. One session per week, 3 credits. Prerequisites: 92.125, 99.131, 92.263.

23.222 Dynamics (ME)

Laws of kinematics of particles and rigid bodies involving absolute and relative motion. Principles of work and energy; impulse and momentum. One session per week, 3 credits. Prerequisites: 92.126, 23.221.

23.223 Mechanics of Materials I

Stress and deformation analysis of bodies under axial, torsional, flexural and combined loading. Also covered are principle stresses, Mohr's stress circle, strain, temperature effects, and shear and moment diagrams. One session per week, 3 credits. Prerequisites: 92.126, 23.221.

23.241 Elements of Thermodynamics I

Study of the first and second laws as applied to a thermodynamic system. The concept of heat and work. Thermodynamic properties of liquids, vapors, and gases. Perfect gas laws. The use of thermodynamic tables and charts. One session per week, 3 credits. Prerequisite: 92.126, 99.132, 92.263.

23.242 Applied Fluid Mechanics

Properties of fluids, the basic concepts: continuity, momentum, hydrostatics, and fluid flow kinematics. Analysis of flow of real fluids in pipes, ducts, and open channels. Study of compressible flows, fluid couplings and torque converters. Flow measurement techniques. One session per week, 3 credits. Prerequisite: 23.222, 92.263.

23.243 Elements of Thermodynamics II

The application of thermodynamic principles. Vapor and gas cycles, refrigeration, energy conversion. The concept of availability and irreversibility. One session per week, 3 credits. Prerequisite: 23.241.

23.295 Materials Science

Study of the mechanical, electrical, thermal, chemical, and magnetic properties of the materials and the dependency of these properties on the crystal structure and atomic arrangement. Methods of altering the structures of materials to obtain desired properties. One session per week, 3 credits. Prerequisite: 84.121, 99.132.

23.302 Mechanics/Materials Laboratory

Experimental study of heat treating of metals, metallography, principle stresses, fatigue and creep. One session per week, 2 credits. Prerequisites: 23.222, 23.223, 23.295, 42.226.

23.320 Machine Design

Class and laboratory. Application of theories of failure, mechanics of materials, and dynamics to the analysis and design of typical machine elements, such as shafts, springs, screws, belts, pulleys, keys, and gears. Problems assigned also illustrate synthesis of ideas applied to design. One session per week, 3 credits. Prerequisites: 23.222, 23.223, 23.295.

23.354 Problems in Mechanical Engineering Technology

A review and extension of applied mechanics. Analytical as well as computer aid solution to the problems in statics, dynamics, and machine design. One session per week, 3 credits. Prerequisites: 23.320, 92.225, 92.263.

23.355 Robotics

Description of robotic systems and their applications. Understanding the basic functions and interactions of robotic subsystems. Exercises in

programming commercially available robots for classroom demonstrations. Methods for determining the capabilities and limitations of robotic subsystems through analysis and experimentation. One session per week, 3 credits. Prerequisites: 23.320, 92.263.

23.356 CAD/CAM

Class and laboratory. Creation of two- and three-dimensional engineering databases using an Interactive Graphics Workstation. Development of mechanical drawings from the standard orthographic and auxiliary views; modification of lines, arcs, text, dimensions and other geometric entities. One session per week, 3 credits. Prerequisites: 23.113, 92.263.

23.405 Senior Project

The application of students' engineering training to a practical problem. The project is judged based on the planning, executing, oral and written progress report, and final report. Work may be individual or team effort, depending upon the complexity of the project. One session per week, 3 credits. Prerequisite: senior status.

23.471 Design of Automatic Machinery

Basic concepts in design of automated machinery with emphasis on selection and integration of standard components and controls. Fundamentals of pneumatic, relay, and microprocessor controls applied to pneumatic, electro-mechanical and mechanical sensing and actuating components. One session per week, 3 credits. Prerequisites: 17.132, 23.320, 92.263.

23.472 Applied Dynamics

Statics and dynamics as applied to general systems with oscillatory motion. The kinematics of periodic motion and the vibrations of systems with single degree of freedom. One session per week, 3 credits. Prerequisites: 92.226, 23.222, 23.223.

23.473 Mechanics of Materials II

Topics include shear center, unsymmetrical bending, energy methods, unit dummy load method, failure theories. One session per week, 3 credits. Prerequisites: 92.226, 23.223.

23.475 Heat Transfer

Study of heat conduction in solids, fluid flow and convective heat transfer, heat exchangers, and heat transmission by radiation. Solution to

problems that arise in practice. One session per week, 3 credits. Prerequisites: 23.241, 23.242, 92.226, 92.263.

23.478 Air Conditioning System

A short review of thermodynamics and heat transfer, thermodynamic properties of moist air, humidity measurement, psychrometric charts, heating and cooling of moist air, solar radiation calculation, heat transmission in buildings, system evaluation and design. One session per week, 3 credits. Prerequisites: 23.241, 23.475.

23.483 Aerodynamics

Fundamentals of subsonic aerodynamics. Airfoil data including Mach number and Reynolds number effects. Circulation, downwash, wing theory, lift and drag, and aircraft performance calculations. One session per week, 3 credits. Prerequisites: 23.242, 92.226, 92.263.

Philosophy

45.201 Introduction to Philosophy

An examination of some of the typical approaches to philosophical questioning and the issues raised in such inquiry: what is true knowledge, what is reality, what is the good, what is the right political order, what is the nature of religious faith? One session per week, 3 credits. Area II core course and Human Values core course.

45.202 Introduction to Logic

A course designed to study the methods used to distinguish correct from incorrect reasoning. It will aim at developing (1) an ability to express one's ideas clearly and concisely, (2) an increased skill in defining one's terms, and (3) a capacity to formulate arguments vigorously and to scrutinize them critically. One session per week, 3 credits. Area II core course.

45.203 Introduction to Ethics

Examination of the basic issues and problems of ethics and value and a survey of some important alternative answers to the questions raised, on both an individual and a social level, by our necessity to act and to live in rational and human way. One session per week, 3 credits. Area II core course and Human Values core course.

45.310 Intermediate Logic

The course will cover modern symbolic logic including both propositional and predicate logic. Emphasis on what can or cannot be proven by mechanical proof procedures. Some of the most important results of modern logic, including Goedel's incompleteness theorem, will be presented and their relevance for computer science will be explored. One session per week, 3 credits.



Physics

99.131 Technical Physics I

Class and laboratory. Vectors; one- and two-dimensional motion; Newton's laws of motion; translational and rotational equilibrium; work and energy; linear momentum; circular motion and gravitation. One session per week, 3 credits. Two Friday night classes will be required. Prerequisites: 90.113, 92.115.

99.132 Technical Physics II

Class and laboratory. Rotational dynamics; mechanical vibrations and waves; sound; solids and fluids; thermal physics; heat and law of thermodynamics. One session per week. Two Friday night classes will be required. 3 credits. Prerequisite: 99.131. Corequisite: 92.125.

99.133 Technical Physics III

Class and laboratory. Reflection, refraction, mirrors, lenses, wave optics, optical instruments, Coulomb's law, magnetic force, quantum physics, atomic physics and nuclear physics. One session per week. Two Friday night classes will be required. 3 credits. Prerequisite: 99.132. Corequisite: 92.126.

Plastics

27.201 Plastics Materials Science I

Class and laboratory. The history, classification, definitions, raw materials, methods of manufacturing, testing-characterizing of typical physical properties, and uses of polymeric material systems with emphasis on thermosetting resins. Discussion of associated economics, rheological behavior, and functional properties of reinforced plastics/composites. Laboratory sessions and demonstrations as scheduled by the instructor. One session per week, 3 credits.

27.202 Plastics Materials Science II

Class and laboratory. A continuation of 27.201 with emphasis on thermoplastics material, including commodity plastics, engineering resin, and specialty polymers. Review of special chemical additives used in materials engineering, discussion of polymer alloys/blends, new materials, and innovations in applied polymer sciences, including adhesives, coatings, elastomers, and man-made fibers. Laboratory sessions and demonstrations as scheduled by the instructor. One session per week, 3 credits.

27.301 Additives for Polymeric Materials

Analysis of additives including stabilizers, plasticizers, fillers and reinforcements, biocides, flame retardants, antistatics agents, and release agents. Special emphasis on the characteristics of each type of additive, compatibility interactions,

and effects on processing. Review of the most current methods of testing efficiency of each additive system. One session per week, 3 credits.

27.303 Reinforced Plastic Composites

Review of composites as a class of materials and the mechanical physical characteristics. Fundamental concepts underlying these properties with particular emphasis on fibrous reinforced plastics. Survey of matrices, reinforcements, and methods of fabrication. One session per week, 3 credits. Prerequisite: 27.202.

27.373 Plastics Mold Engineering I

Class and laboratory. Introduction to the principles of basic mold and die design and construction. Laboratory design of molds and/or dies to be constructed in continuing portions of this course. Lecture, laboratory and demonstrations at the discretion of the instructor. One session per week, 3 credits.

27.376 Plastics Mold Engineering II

Continuation of 27.373. One session per week, 3 credits.

27.401 Processing Technology I

Class and laboratory. Theory and methods of processing plastics materials including compounding, molding, extruding and thermoforming. Evaluation and development of typical

problems. Laboratory sessions and demonstrations as scheduled by the instructor. One session per week, 3 credits. Prerequisite: 27.202.

27.402 Processing Technology II

Class and laboratory. A continuation of 27.401, which touches extensively upon casting, laminating, fabricating, and finishing. Correlation of composition, processing and fabricating with product design and applications is also covered. Laboratory sessions and demonstrations as scheduled by the instructor. One session per week, 3 credits. Prerequisite: 27.401.

27.403 Physical Properties of Polymers I

Introduction to basic mechanical properties of polymers as linear viscoelastic materials. Concepts of creep, stress relaxation, and superposition principles emphasized. Dynamic mechanical behavior, interrelations between various properties, electrical behavior, miscellaneous mechanical properties, optical properties. One session per week, 3 credits. Prerequisite: Senior Status.

27.404 Physical Properties of Polymers II

A continuation of 27.403. One session per week, 3 credits.

27.405 Polymer Characterization

Instrumental methods of characterizing plastics materials. The theory and interpretation of infrared spectroscopy, gas chromatography, gel permeation chromatography, differential thermal analysis, thermal gravimetric analysis, osometry, etc. The determinations will include elucidation of structure, identification, molecular weight, molecular weight distribution and glass transition temperatures. One session per week, 3 credits. Prerequisite: 84.122, permission of Coordinator.

27.406 Polymer Structures

The fundamental relationship between molecular structure, properties and end-use applications of plastic materials will be explored in detail. Molecular structural features include chemical composition, molecular size and flexibility, intermolecular order and binding, and supermolecular structure. Properties include processability, mechanical, acoustic, thermal, electrical, optical and chemical properties, price, and balance of properties. Applications include rigid

solids, flexible solids, foams, film, and non-plastic applications. Prerequisite: permission of Coordinator. One session per week, 3 credits.

27.407 Plastics Industry Organization

Economics of producing plastics raw materials and converting them into end products, from research and development to plant construction, operation and marketing. Market analysis of plastics production, processing, and consumer patterns: commercial development, sales, and technical service. Organization of the plastics industry for research and development, specialty and commodity production, profit and growth. Prerequisite: permission of Coordinator. One session per week, 3 credits.

27.451 Selected Topics in Polymers I

Specialized topics in applied polymer science, adhesives, elastomers, coatings, and fibers as well as other timely subjects. One session per week, 3 credits. Prerequisite: permission of Coordinator.

27.452 Selected Topics in Polymers II

Continuation of 27.451, which is a prerequisite, also permission of Coordinator. One session per week, 3 credits.



Political Science

46.101 Introduction to American Politics

An introductory analysis of the structures, functions, and behavior of the American political community. The analysis will emphasize politics and political behavior at the national level. One session per week, 3 credits. Area I core course.

46.121 Introduction to International Relations

Surveys of some recent methods and approaches used in the study of international politics and the introduction to current problems of foreign policies of major world powers. One session per week, 3 credits. Area I core course.

46.230 Law and the Legal System

An introduction to the nature of the legal process and the operation of the American Legal System; considerations of its political and social functions. One session per week, 3 credits.

46.260 Public Administration

An introductory study of bureaucratic organization and behavior in American society. One session per week, 3 credits.

46.282 Contemporary Political Theory

An examination of major ideological currents in the contemporary world. Marxism, communism, fascism, anarchism, and the relevance of Freud to modern political thought are some of the possible topics for examination. One session per week, 3 credits. Area I core and Human Values core course.

46.344 The American Presidency

An examination of the nature of the American Presidency and its functioning within the American political system. Specific attention will be given to the problems and the evolution of the presidency since World War I. One session per week, 3 credits.

46.345 Constitutional Law and Politics

An advanced study of judicial review and judicial behavior as they have developed through the historical process of constitutional adjudication. Special emphasis is given to the continuing tension between judicial review and American democracy. One session per week, 3 credits.

46.347 Civil Liberties, Law, and Politics

An advanced examination of the developments of American concepts of civil liberty and equal rights through the historical process of constitutional adjudication and in other areas of the law, government, and society. One session per week, 3 credits.

46.356 Public Policy Analysis

The application of analytical techniques to the evaluation of governmental policy options. One session per week, 3 credits.

46.380 Contemporary American Foreign Policy

A study of the process of American foreign policy in the contemporary world. The case study method will be used to illustrate problems of strategy and tactics in such areas as Europe, Latin America, Africa, and the Near East. One session per week, 3 credits.



Psychology

47.101 General Psychology

A basic introductory course, primarily for non-concentrators, surveying the major areas of psychology, including the nature of psychology as a science, learning, human development and personality, perception, and motivation, behavioral disorders, and social behavior. One session per week, 3 credits. Area I core course.

47.163 The Human Life Span

Primarily for non-concentrators, this course surveys the major stages and processes in human development from birth to death. One session per week, 3 credits. Area I core course.

47.209 Social Psychology

An introduction to the study of social behavior in interpersonal relationships, groups, organizations, and the community. Topics include attitudes and attitude change, group dynamics, leadership, and interpersonal influences. One session per week, 3 credits. Area I core course and Human Values core course.

47.232 Psychology of Personality

A survey of the major theories of personality, beginning with Freud and psychoanalysis, the neo-Freudians, existential psychology, humanistic theories of Rogers and Maslow, and behavioristic and social learning theories. The interplay between theory and research is also considered. One session per week, 3 credits. Area I core course.

47.255 Community Psychology

A survey of the nature and practice of community psychology, including principles of community organization and change, as seen in such areas as education, mental health, corrections, and social services. Students will participate in field research or practice under the direction of an assigned agency, and classroom work will include discussion of the field experiences of the participants. One session per week, 3 credits. Area I core course.

47.261 Child Psychology

An introduction to theory and research in the field of child psychology. Using a chronological approach, the course covers the concepts and processes of child development. One session per week, 3 credits.

47.262 Adolescent Psychology

An examination of developmental issues during adolescence, including personality development and the emergence of identity, peer relations, the development of moral values, and sources of maladjustment. One session per week, 3 credits. Area I core course.

47.272 Abnormal Psychology

An introduction to the study of various patterns of neurotic, psychotic, and character disorders. Therapeutic techniques and other auxiliary methods for the treatment of such disorders are studied in relation to contemporary theory and research. One session per week, 3 credits. Prerequisite: 47.101. Area I core course.

47.328 Dynamics of Interpersonal Relations

An analysis of psychological dynamics in interpersonal behavior, emphasizing such topics as conformity, leadership, interpersonal growth, self-disclosure, personal styles of interaction, and technique of change. The primary focus will be on the behavior of the students themselves who form a small group in which they are expected to participate. The course is taught without a formal prerequisite, but students should have some previous course work in psychology. One session per week, 3 credits. Area I core course.

47.335 Psychology of Women

A consideration of such topics as: the psychology of sex differences; sex roles and socialization; sex stereotypes and attitudes toward women; women's self-concept and achievement; biological basis of psychological sex differences; the nature of female sexuality; clinical theory and practice concerning women; women as mental patients and mental health consumers; implications for psychology and for women's status. One session per week, 3 credits. Area I core course and Human Values core course.

47.352 Psychological Tests and Measurement

A survey of several major tests used to assess such factors as mental abilities, vocational interest, attitudes, and personality. Students learn to administer, score, and interpret specific tests and the ways in which information is compiled to complete a case study of individuals tested. One session per week, 3 credits.

tested. One session per week, 3 credits.

47.364 Psychology of Crime and Corrections

An investigation of the psychological aspects of crime and deviance and the nature of punishment and rehabilitation. Clinical case histories or criminal personalities will be combined with experimental studies of anti-social and violent behavior. The nature of prisons and criminal justice will also be examined. One session per week, 3 credits. Prerequisite: 47.272. Area I core course.

47.371 Behavior Problems of Childhood

This course examines specific aspects of disorder occurring during childhood and early adolescence, including neurotic disorders, autism and psychosis, retardation and learning disabilities, and conduct disorders. Case histories and research dealing with assessment, etiology, and treatment will be presented. One session per week, 3 credits. Prerequisite: 47.261 or 47.272.

Sociology

48.101 Introduction to Sociology

This is the basic course in sociology. Emphasis is directed at the ways in which social institutions such as government, schools, the economy, social class, and the family develop and influence our lives. It is concerned not only with presenting various ways to understand our relationship to society, but also with ways to change it. One session per week, 3 credits. Area I core course.

48.201 Social Anthropology

Using the comparative approach to the study of society, this course examines several distinct cultures as a means of understanding both the universal constants and the variations in human societies. One session per week, 3 credits. Area I core course and Human Values core course.

48.220 Self Assessment and Career Development

A study of the meaning of work in our society. Class participants will assess their own life experiences and develop plans to integrate interests, values, and abilities into meaningful and realistic life/work options. One session per week, 3 credits.

47.473 Seminar in Social Psychology

Intensive study of one or more of the following special topics in social psychology including the following: psychology of the family and parent-child relations, oral development, adjustment during adulthood, death and dying, etc. One session per week, 3 credits. Prerequisites: 47.101, 47.209.

48.231 Sociology of the Family

A study of the nature of the family in contemporary society with particular emphasis on the family in America. What functions does the family perform in modern society? How is it changing? How do these changes affect our lives? One session per week, 3 credits. Area I core course.

48.234 The Study of Minorities

This course examines the process of immigration and majority-minority relations in the U.S. over the last century with particular emphasis on the process of adaptation in a pluralistic society. One session per week, 3 credits. Prerequisite: 48.101. Area I core course and Human Values core course.

48.241 Sociology of Women

The women's movement has changed our accepted views of women and men. This course will seek for an understanding of the positions of women and men in culture, the economy, the family and political life. Crucial are the questions: "What do we want?" and "What do we need?" Specific topics will be examined. Area I core course and Human Values core course.

48.256 Political Sociology

This course focuses on the development and use of power in modern society. Emphasis is placed on the relationship of American political institutions to economic institutions, to social class, and to supporting ideologies. One session per week, 3 credits. Prerequisite: 48.101.

48.323 Sociology of Ideas and Values

This course is geared to the student with little or no background in sociology or philosophy and seeks to clarify what we mean by values, ideas and concepts. The course investigates the social processes that affect the way we perceive and think about objects, social events, and interpersonal relations. The source of "correct" ideas is investigated. Ideology and culture are studied closely. Science and technology are analyzed as social processes. The question of values is brought up in relation to technology, the quality of life, and our relationship to nature. One session per week, 3 credits.

48.341 Social Stratification

This course focuses on the phenomenon of social class distinctions with particular emphasis on social class in America. The approach taken is both historical and sociological. One session per week, 3 credits. Prerequisite: 48.101. Area I core course.

48.345 Urban Sociology

This course deals with issues related to the quality of life in American cities. Students taking this course may engage in research projects on the city of Lowell and the role of the University of Lowell within that city. One session per week, 3 credits.

48.351 The Sociology of Health and Health Care

A historical and contemporary study of the socio-politics of health, illness, and the health care industry in the United States. Attention is given to providers, consumers, owners, workers, and professionals in terms of their power, class, race, sex, and age. Reforms and alternatives are considered. One session per week, 3 credits. Prerequisite: 48.101.

48.361 Sociology of Law and the Criminal Justice System

Introduction to the theory, structure, ideology, and practice of the criminal justice system. Particular attention is directed at the definition of crime and the impact of social, political, and economics policy on the operation of systems and their impact on its "clients". One session per week, 3 credits. Prerequisite: 48.101. Area I core course.



Degree Requirements



College of Engineering

Aldo Crugnola, Dean; A.B., M.S., Sc.D.

Louis Petrovic, Assistant Dean, B.S., M.S., M.B.A., Ph.D.

Mukti L. Das, Civil Engineering Technology Coordinator, B. Eng., M.S., Ph.D.

J. Robert A. Lemieux, Electronic Engineering Technology Coordinator, B.S., M.S.

Majid Charmchi, Mechanical Engineering Technology Coordinator, B.S., M.S., Ph.D.

The College of Engineering offers the following Continuing Education undergraduate programs: Associate of Science in Engineering Technology (Civil, Electronic, and Mechanical), Bachelor of Science in Engineering Technology (Civil, Electronic, and Mechanical), and Bachelor of Science in Industrial Technology (Options in Manufacturing Technology, Water and Industrial Waste Technology, and Plastics Technology)

I Civil Engineering Technology

Associate of Science and Bachelor of Science Programs

Suggested Course of Study

Years 1 - 4 Leading to the Degree of Associate of Science in Engineering Technology: 68 Credits

First Year

First Semester (September)

Subject Number		Credits
90.113	College Algebra	3
23.111	Engineering Drawing I	2
92.263	FORTRAN Programming	3
		8

Second Semester (January)

Subject Number		Credits
92.115	College Trigonometry	3
15.113	CAD	2
42.101	College Writing I	3
		8

Second Year

15.123	Surveying I	4
92.125	Calculus A	3
99.131	Technical Physics I	3
		10

15.124	Surveying II	4
92.126	Calculus B	3
15.237	Statics	3
		10

Third Year

99.132	Technical Physics II	3
15.246	Introduction to Hydraulics	3
42.102	College Writing II	3
		9

15.239	Strength of Materials	3
15.247	Hydraulics Laboratory	1
42.226	Technical and Scientific Communication	3
		7

Fourth Year

15.254	Soil Mechanics I	3	15.257	Highway Elements	3
15.251	Structural Analysis I	3	15.242	Steel Design I	3
15.253	Reinforced Concrete I	<u>3</u>	15.224	Material/Structural Laboratory	<u>1</u>
		9			7

Years 5 - 8 Leading to the Degree of Bachelor of Science in Engineering Technology: 134 Credits

Fifth Year

First Semester (September)

Subject Number	Credits
84.111 General Chemistry I	3
84.113 General Chemistry I Laboratory	1
..... Area II Elective	<u>3</u>
	7

Second Semester (January)

Subject Number	Credits
15.392 Soil Mechanics II	3
15.383 Steel Design II	3
15.394 Soil Mechanics Laboratory	<u>1</u>
	7

Sixth Year

15.356	Environmental Technology	3	15.391	Reinforced Concrete II	3
99.133	Technical Physics III	3	15.238	Dynamics	3
92.225	Calculus C	<u>3</u>	15.256	Water and Distribution Laboratory	<u>1</u>
		9			7

Seventh Year

68.201	Economics I (Microeconomics)	3	15.352	Structural Analysis II	3
17.130	Electrical Basics and Laboratory	2	68.202	Economics II (Macroeconomics)	3
92.383	Introduction to Statistics	<u>3</u>	.....	Area II Elective	<u>3</u>
		8			9

Eighth Year

15.463	Construction Technology	3	15.470	Project Management	3
20.414	Industrial Economic Management	3	15.486	Transportation Elements	3
.....	Human Values Elective	<u>3</u>	.....	Area I or II Elective	<u>3</u>
		9			9

II Electronic Engineering Technology

Associate of Science and Bachelor of Science Programs

Suggested Course of Study

Years 1 - 4 Leading to the Degree of Associate of Science in Engineering Technology: 65 Credits

First Year

First Semester (September)

Subject Number	Credits
42.101 College Writing I	3
90.113 College Algebra	3
..... Area I Elective	<u>3</u>
	9

Second Semester (January)

Subject Number	Credits
42.102 College Writing II	3
92.115 College Trigonometry	3
92.219 BASIC Programming	<u>3</u>
	9

Second Year

17.213 Electric Circuits	3	17.214 Circuits and Laboratory I	2
92.125 Calculus A	3	92.126 Calculus B	3
42.226 Technical and Scientific Communication	<u>3</u>	99.131 Technical Physics I	<u>3</u>
	9		8

Third Year

17.215 Circuits and Laboratory II	2	17.216 Advanced Circuits	3
17.355 Electronics and Laboratory I	2	17.356 Electronics and Laboratory II	2
99.132 Technical Physics II	<u>3</u>	99.133 Technical Physics III	<u>3</u>
	7		8

Fourth Year

17.350 Control Systems I	3	17.353 Digital Electronics	3
17.357 Electronics and Laboratory III	2	17.358 Electronics and Laboratory IV	2
17.371 Logic Design I	<u>3</u>	17.380 Microprocessor Basics	<u>2</u>
	8		7

Students enrolling in this program should purchase an electronic calculator capable of handling logarithmic and trigonometric functions. The use of the calculator will be an integral part of courses 17.213 and 17.214, where proficiency will be developed. Competency in the use of the calculator will be assumed in all subsequent EET courses. Proper approval for a 17.4-- course is automatically assumed if all prerequisites are satisfied. Proper approval for Area I, Area II or Human Values courses is automatically assumed if all prerequisites are satisfied and the course is selected from those listed in this catalog. Any changes to the list of approved courses will be posted in the Continuing Education Office. Proper approval for course substitution or other deviation from the above can be obtained only by written permission.

Years 5 - 8 Leading to the Degree of Bachelor of Science in Engineering Technology: 132 Credits

Fifth Year

First Semester (September)

Subject Number	Credits
17.367 Digital Devices and Laboratory	2
17.372 Logic Design II	3
92.225 Calculus C	<u>3</u>
	8

Second Semester (January)

Subject Number	Credits
17.368 Data Conversion and Laboratory	2
17.317 Minicomputer Programming	3
92.226 Calculus D	<u>3</u>
	8

Sixth Year

17.365 Applied Linear Devices	3
92.234 Differential Equations	3
92.265 Pascal Programming	<u>3</u>
	9

17.361 Project Laboratory A	2
17.376 Electromagnetic Theory I	3
17.382 Problems in E.E. Technology	<u>3</u>
	8

Seventh Year

17.4... EET Elective	3
17.4... EET Elective	3
..... Area II Elective	<u>3</u>
	9

17.4... EET Elective	3
..... Human Values Elective	3
..... Area II Elective	<u>3</u>
	9

Eighth Year

68.201 Economics I (Microeconomics)	3
17.391 Project Laboratory B	2
17.4... EET Elective	<u>3</u>
	8

68.202 Economics II (Macroeconomics)	3
17.392 Project Laboratory C	2
17.4... EET Elective	<u>3</u>
	8

III Industrial Technology

Bachelor of Science in Industrial Technology Programs

1. Manufacturing Option: 135 Credits

Suggested Course of Study

First Year

First Semester (September)

Subject No.		Credits
42.101	College Writing I	3
90.113	College Algebra	3
67.201	Accounting Principles I	<u>3</u>
		9

Second Semester (January)

Subject No.		Credits
42.102	College Writing II	3
92.115	College Trigonometry	3
47.101	General Psychology	<u>3</u>
		9

Second Year

20.105	Introduction to Engineering Design	3
48.101	Introduction to Sociology	3
92.125	Calculus A	<u>3</u>
		9

20.112	Machine Tool Processes	3
92.126	Calculus B	3
99.131	Technical Physics I	<u>3</u>
		9

Third Year

23.221	Statics	3
84.111	General Chemistry I	3
84.113	General Chemistry Lab I	<u>1</u>
		7

68.201	Economics I (Microeconomics)	3
42.226	Technical and Scientific Communication	3
92.383	Introduction to Statistics	<u>3</u>
		9

Fourth Year

20.201	Introduction to Materials	3
20.307	Fluid Power Controls	3
20.310	Industrial Safety	<u>3</u>
		9

20.303	Mechanical Systems	3
69.353	Organizational Behavior	3
20.211	Industrial Materials Laboratory	<u>1</u>
		7

Fifth Year

First Semester (September)

Subject No.		Credits
27.201	Plastics Materials Science I	3
20.314	Motion and Time Study	3
20.202	Industrial Computer Science	<u>3</u>
		9

Second Semester (January)

Subject No.		Credits
69.321	Marketing Principles	3
20.416	Statistical Quality Control	3
20.406	Energy Conversion Technology	<u>3</u>
		9

Sixth Year

20.305	Manufacturing Processes	3
17.130	Electrical Basics and Laboratory	2
17.131	Electronic Basics and Laboratory	<u>2</u>
		7

69.371	Operations Management	3
.....	Technical Elective	3
.....	Area II Elective	<u>3</u>
		9

Seventh Year

20.309	Process Measurement and Control	2
.....	Technical Elective	3
.....	Free Elective	<u>3</u>
		8

20.402	Manufacturing Operations	3
17.132	Digital Basics and Laboratory	2
.....	Area II Elective	<u>3</u>
		8

Eighth Year

20.408	Microprocessors	2
.....	Technical Elective	3
.....	Free Elective	<u>3</u>
		8

20.414	Industrial Economic Management	3
.....	Free Elective	3
.....	Human Values Elective	<u>3</u>
		9

Technical electives must be selected from one area of emphasis -- Manufacturing, Safety Engineering, or Management. Approved Technical Electives for Area of emphasis follow: (may require prerequisites which automatically qualify as technical electives). Alternative areas of emphasis may be submitted by the student for approval by the Coordinator.

Manufacturing	Safety	Management
23.222	20.429	69.321
20.303	20.431	69.426
20.427	20.432	69.201
27.401	20.433	
27.303	20.433	
23.471	20.430	
27.202		

2. Plastics Technology Option: 141 Credits

Suggested Course of Study

First Year

First Semester (September)

Subject No.	Credits
42.101 College Writing I	3
90.113 College Algebra	3
84.121 Chemistry I	<u>3</u>
	9

Second Semester (January)

Subject No.	Credits
42.102 College Writing II	3
92.115 College Trigonometry	3
84.122 Chemistry II	<u>3</u>
	9

Second Year

84.223 Principles of Organic Chemistry I	3
92.125 Calculus A	3
23.111 Engineering Drawing I	<u>2</u>
	8

42.226 Technical and Scientific Communication	3
92.126 Calculus B	3
84.224 Principles of Organic Chemistry II	<u>3</u>
	9

Third Year

27.201 Plastics Materials Science I	3
99.131 Technical Physics I	3
27.401 Processing Technology I	<u>3</u>
	9

27.202 Plastics Materials Science II	3
99.132 Technical Physics II	3
27.402 Processing Technology II	<u>3</u>
	9

Fourth Year

27.406 Polymer Structures	3
27.301 Additives for Polymeric Materials	3
27.373 Plastics Mold Engineering I	<u>3</u>
	9

27.303 Reinforced Plastics/Composites	3
68.201 Economics I (Microeconomics)	3
..... Area I Elective	<u>3</u>
	9

Fifth Year

First Semester (September)

Subject No.		Credits
92.383	Introduction to Statistics	3
69.321	Marketing Principles	3
20.202	Industrial Computer Science	<u>2</u>
		9

Second Semester (January)

Subject No.		Credits
20.416	Statistical Quality Control	3
69.451	Personnel Management	3
.....	Area II Elective	<u>2</u>
		9

Sixth Year

20.310	Industrial Safety	3
23.221	Statics	3
27.403	Physical Properties of Polymers I	<u>2</u>
		9

.....	Area I or II Elective	3
.....	Technical Elective	3
27.404	Physical Properties of Polymers II	<u>2</u>
		9

Seventh Year

17.130	Electrical Basics and Laboratory	3
20.307	Fluid Power Control	3
20.309	Process Measurement and Control	<u>2</u>
		8

69.371	Operations Management	3
.....	Area I Elective	3
.....	Technical Elective	<u>2</u>
		9

Eighth Year

27.407	Plastics Industry Organization	3
20.408	Microprocessors	2
.....	Human Values Elective	<u>2</u>
		8

.....	Technical Elective	3
20.402	Manufacturing Operations	3
.....	Technical Elective	<u>2</u>
		9

Technical Electives may be chosen from business, computer, engineering technology or other technological programs.

3. Water and Wastewater Technology Option: 135 Credits

Suggested Course of Study

First Year

First Semester (September)

Subject Number	Credits
42.101 College Writing I	3
90.113 College Algebra	3
67.201 Accounting Principles I	<u>3</u>
	9

Second Semester (January)

Subject Number	Credits
42.102 College Writing II	3
92.115 College Trigonometry	3
..... Free Elective	<u>3</u>
	9

Second Year

92.125 Calculus A	3
84.111 General Chemistry I	3
84.113 General Chemistry Laboratory I	<u>1</u>
	7

99.131 Physics I	3
92.126 Calculus B	3
20.105 Introduction to Engineering Design	<u>3</u>
	9

Third Year

20.251 Wastewater Treatment Plant Operations I	3
20.253 Wastewater Treatment Laboratory I	1
20.225 Water Chemistry I	<u>3</u>
	7

20.252 Wastewater Treatment Plant Operations II	3
20.254 Wastewater Treatment Laboratory II	1
20.152 Water Biology	<u>3</u>
	7

Fourth Year

17.130 Electrical Basics and Laboratory	2
17.131 Electronic Basics and Laboratory	2
20.351 Water Supply and Treatment Operation I	<u>3</u>
	7

20.352 Water Supply and Treatment Operations II	3
20.452 Operation and Maintenance of Wastewater Collection Systems I	3
42.226 Technical and Scientific Communication	<u>3</u>
	9

Fifth Year

First Semester (September)

Subject No.	Credits
20.255 Water Distribution Systems	3
20.201 Introduction to Materials	3
23.221 Statics	<u>3</u>
	9

Second Semester (January)

Subject No.	Credits
..... Technical Elective	3
20.356 Hazardous Waste Management	3
20.354 Industrial Waste Treatment	<u>3</u>
	9

Sixth Year

15.123 Surveying I	4
92.383 Introduction to Statistics	3
..... Area II Elective	<u>3</u>
	10

20.353 Water Works Operations Lab I	1
20.257 Water/Wastewater Plant Management I	3
20.416 Statistical Quality Control	<u>3</u>
	7

Seventh Year

20.357 P/C Treatment of Industrial Wastewater I	3
20.310 Industrial Safety	3
69.371 Operations Management	<u>3</u>
	9

20.453 O & M of Wastewater Collection Systems II	3
68.201 Economics I (Microeconomics)	3
20.202 Industrial Computer Science	<u>3</u>
	9

Eighth Year

20.414 Industrial Economic Management	3
..... Technical Elective	3
..... Area II Elective	<u>3</u>
	9

..... Area I or II Elective	3
..... Human Values Elective	3
47.101 General Psychology	<u>3</u>
	9

All technical electives must be approved by the Program Coordinator.

IV Mechanical Engineering Technology

Associate of Science and Bachelor of Science Programs

Suggested Course of Study

Years 1-4 Leading to the Degree of Associate of Science in Engineering Technology: 66 Credits

First Year

First Semester (September)

Subject No.		Credits
90.113	College Algebra	3
23.111	Engineering Drawing I	2
42.101	College Writing I	<u>3</u>
		8

Second Semester (January)

Subject No.		Credits
92.115	College Trigonometry	3
23.112	Engineering Drawing II	2
42.102	College Writing II	<u>3</u>
		8

Second Year

92.125	Calculus A	3
99.131	Technical Physics I	3
42.226	Technical and Scientific Communication	<u>3</u>
		9

92.126	Calculus B	3
99.132	Technical Physics II	3
92.263	FORTTRAN Programming	<u>3</u>
		9

Third Year

23.113	Machine Drawing	2
23.221	Statics	3
84.121	Chemistry I	<u>3</u>
		8

17.130	Electrical Basics and Laboratory	2
23.222	Dynamics	3
23.295	Materials Science	<u>3</u>
		8

Fourth Year

23.241	Elements of Thermodynamics I	3
23.242	Applied Fluid Mechanics	3
23.223	Mechanics of Materials	<u>3</u>
		9

17.131	Electronic Basics and Laboratory	2
23.320	Machine Design	3
23.202	Thermo/Fluids Laboratory	<u>2</u>
		7

Years 5-8 Leading to the Degree of Bachelor of Science in Engineering Technology: 136 Credits

Fifth Year

First Semester (September)

Subject No.		Credits
99.133	Technical Physics III	3
92.225	Calculus C	3
.....	Area II Elective	<u>3</u>
		9

Second Semester (January)

Subject No.		Credits
17.132	Digital Basics and Laboratory	2
92.226	Calculus D	3
23.354	Problems in M.E.T.	<u>3</u>
		8

Sixth Year

23.356	CAD/CAM	3
23.302	Mechanics/Materials Laboratory	2
.....	Area II Elective	<u>3</u>
		8

47.101	General Psychology	3
23.243	Elements of Thermodynamics II	3
.....	Human Values Elective	<u>3</u>
		9

Seventh Year

68.201	Economics I (Microeconomics)	3
23.475	Heat Transfer	3
.....	Free Elective	<u>3</u>
		9

68.202	Economics II (Macroeconomics)	3
23.471	Design of Automatic Machinery	3
.....	Free Elective	<u>3</u>
		9

Eighth Year

20.414	Industrial Economic Management	3
20.305	Manufacturing Processes	3
.....	Technical Elective	<u>3</u>
		9

23.405	Senior Project	3
.....	Technical Elective	3
.....	Area I or II Elective	<u>3</u>
		9

All technical electives must be approved by the Program Coordinator.



College of Liberal Arts

Peter Blewett, Acting Dean; A.B., A.M., Ph.D.
Richard L. Derry, Assistant Dean; A.B., A.M.
Donald R. Berry, Liberal Arts Coordinator; A.B., M.A.

The College of Liberal Arts offers the following undergraduate programs through Continuing Education: Associate of Science (Public Service: Administration of Criminal Justice), Bachelor of Science (Public Service: Administration of Criminal Justice), and Bachelor of Liberal Arts (single concentration option).

I Public Service: Administration of Criminal Justice

Associate of Science - 61 Credits

- | | | |
|----|---|------------|
| A. | General University Requirements | 34 credits |
| B. | Criminal Justice Requirement (asterisked) | 18 credits |
| C. | Free Electives (with permission of coordinator) | 9 credits |

Bachelor of Science - 121 Credits
(Enforcement, Corrections, or Law and the Courts Tracks)

- A. General University Requirements
Total: 34 credits

- | | | |
|--------|--------------------|-----------|
| 42.101 | College Writing I | 3 credits |
| 42.102 | College Writing II | 3 credits |

Area I 9 credits
(Must include 47.101 General Psychology and 48.101 Introduction to Sociology)

Area II 9 credits

Area III 10 credits
(Must include 90.112 and 90.119 Concepts in Algebra I and II, plus one science/laboratory course)

- B. Criminal Justice Requirements
Total: 36 credits

There are three main areas of tracks which a student may elect: Enforcement, Corrections, or Law and the Courts. Courses suggested for one track are not exclusive, however, and some crossover is desirable.

Enforcement

- *+44.101: The Criminal Justice System
- * 44.141: Police Functions: Theory and Applications
- *+44.221: Criminology I
- +44.234: Criminal Law
- *44.243: Criminalistics I
- 44.244: Criminalistics II
- *44.261: Juvenile Delinquency
- 44.341: Comparative Police Systems
- 44.371: Criminal Justice Management
- 44.373: Issues in Police Administration
- +44.390: Research Methods in Criminal Justice
- +44.490: Research Seminar in Criminal Justice
- +44.496: Practicum (In-service students will substitute 44.370 or 44.371)

Law and the Courts

- +44.101: The Criminal Justice System
- +44.221: Criminology I
- 46.230: Law and the Legal System
- +44.234: Criminal Law
- 44.261: Juvenile Delinquency
- 44.321: Criminology II
- 44.331: Penal Law
- 44.335: Juvenile Court Philosophy and Practice
- 44.354: Probation and Parole
- 44.360: Minorities and the Criminal Justice System
- 44.371: Criminal Justice Management
- 44.380: Selected Issues in Law and Justice
- +44.390: Research Methods in Criminal Justice
- +44.490: Research Seminar in Criminal Justice
- +44.496: Practicum (In-service students will substitute 44.370 or 44.371)

*Associate Degree Courses

+Bachelor Degree Courses

Corrections

- *+44.101: The Criminal Justice System
- 46.230: Law and the Legal System
- 44.151: Introduction to Corrections
- *+44.221: Criminology I
- *+44.234: Criminal Law
- *44.261: Juvenile Delinquency
- 44.331: Penal Law
- 44.351: Alternatives in Corrections
- 44.354: Probation and Parole
- 44.371: Criminal Justice Management
- 44.372: Issues in Correctional Administration
- +44.390: Research Methods in Criminal Justice
- +44.490: Research Seminar in Criminal Justice
- +44.496: Practicum (In-service students will substitute 44.370 or 44.371)

*Associate Degree Courses

+Bachelor Degree Courses

C. Additional Requirements
Total: 54 credits

1. Cross-Discipline Courses 15 credits
(5 courses selected from the following list)

- 43.308 History of Crime, Conflict and Social Control in the U.S.
- 43.309 English Constitutional Law and Legal History
- 46.230 Law and the Legal System
- 46.260 Public Administration
- 46.345 Constitutional Law and Politics
- 46.347 Civil Liberties, Law and Politics
- 46.356 Public Policy Analysis
- 47.364 Psychology of Crime and Corrections
- 48.361 Sociology of Law and the Criminal Justice System

2. Free Electives 27 credits
(Selected with permission of Coordinator)

3. Professional Skills 12 credits

Professional skills requirements can be satisfied in either one of the following areas:

a. Foreign Language (Intermediate level proficiency required)

b. Computer Sciences (The following sequence of 12 semester hours is required.)

- 92.209 Introduction to BASIC or 92.202 Microcomputer and Applications Software
- 92.383 Introduction to Statistics
- 93.363 Introduction to Data Analysis (S.P.S.S.)

and one of the following:

- 92.263 FORTRAN Programming
- 92.265 Pascal Programming
- 92.365 COBOL Programming I

II Social Science

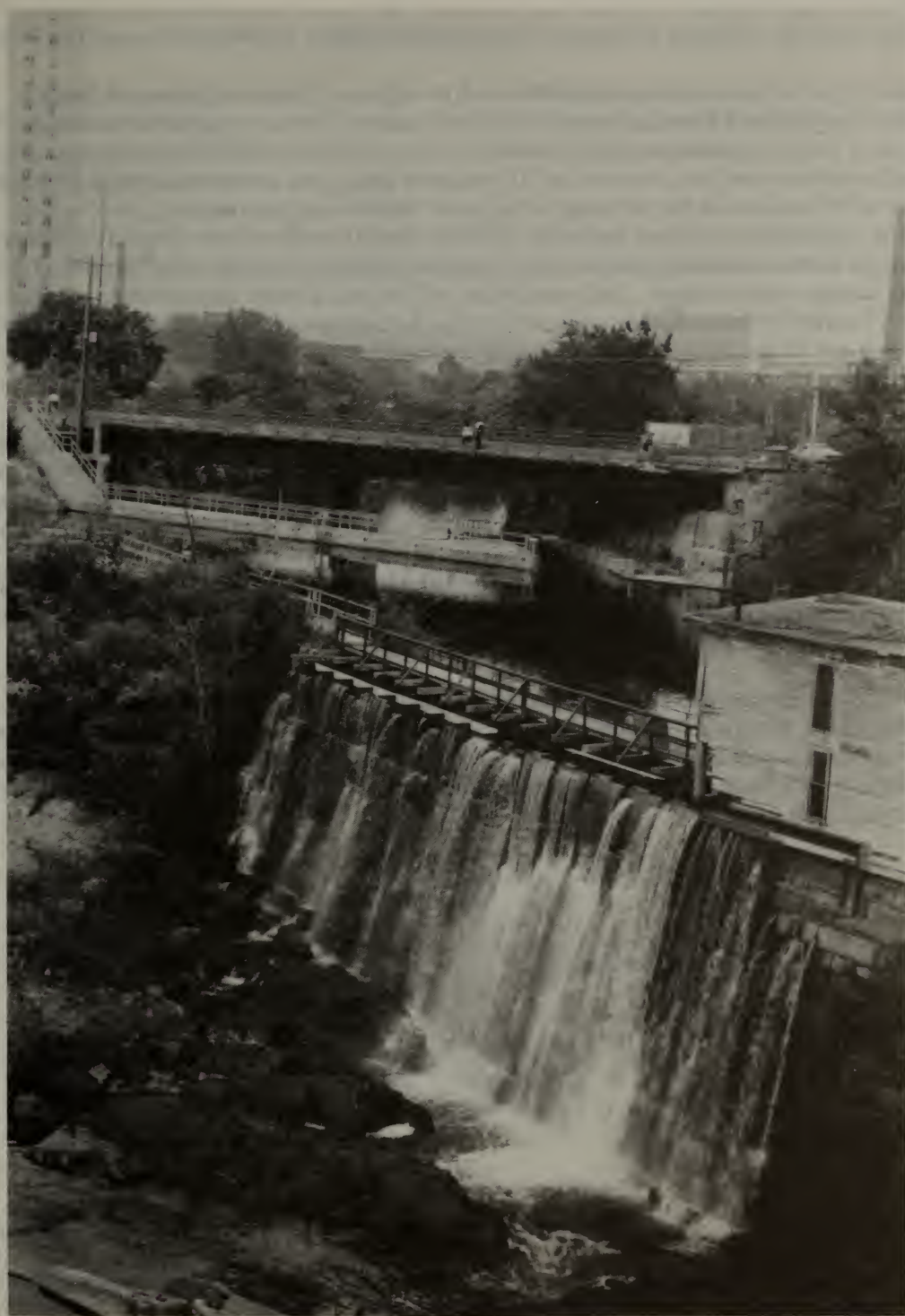
Bachelor of Liberal Arts - 120 Credits

- I. General University Requirements (33 - 35 credits)
 - A. College Writing I and II 6 credits
 - B. University Core Requirements 27 - 29 credits
- II. Social Sciences Major (minimum 36 - maximum 60 credits)
 - A. Area of Concentration minimum 18 credits
 - B. Second Area of Social Sciences minimum 6 credits
 - C. Third Area of Social Sciences minimum 6 credits
- III. Option Minor 18 - 24 credits
- IV. Elective Courses remaining credits

Presently, students may select a concentration from Sociology, Psychology, History, and Political Science. Students must earn a 2.20 cumulative grade point average in their area of concentration by the end of their senior year and must select at least 15 credit hours in 300-level courses or higher. Students selecting Psychology or Sociology as their area of concentration must take a 400-level seminar which has as its prerequisites the 6 courses (18 credits) previously taken in concentration.

Students may select a minor (18-24 credits) in humanities, economics, computer mathematics option, mathematics. Mathematics minor must contain no courses less than Calculus I with 6 credits in 300-level courses or higher.

Electives may be chosen from economics, chemistry, science, mathematics, computer mathematics science, clinical laboratory sciences, behavioral and social sciences, fine arts and humanities. In addition, minor courses may also include accounting (67.201, 67.202, 67.301, 67.302) and management (69.201, 69.321, 69.332, 69.353).



College Of Management Science

Linda H. Kistler, Acting Dean: B.S.B.A., M.S., C.P.A.

Santo J. Pullara, Coordinator: B.S., M.B.A., J.D., Ph.D.

Transfer to Bachelor of Science in Business Administration Program, University of Lowell Day Programs

Associate degree students who desire to graduate with the degree of Bachelor of Science in Business Administration must seek formal admission as a transfer student to the day program of the College of Management Science. Admission to the Bachelor of Science in Business Administration degree program is restricted to students who have maintained a 2.0 cumulative grade-point average and who have completed a minimum of 60 semester credits, including certain basic courses in required subjects, either at the University or at another accredited institution. Students should consult with the Dean of the College of Management Science concerning policies and procedures which govern transfer to the Bachelor of Science in Business Administration program. Such consultation will determine which courses can be accepted without validation for transfer credit. Students who are accepted for transfer to this program will be permitted to pursue their day studies full time or (in conformity with regulations of the Second Chance Program) on a part-time basis.

Students who are accepted for transfer to the Bachelor of Science in Business Administration program are subject to a validation requirement. Validation generally will be required if an upper-level course of the Bachelor of Science in Business Administration program has been completed prior to transfer acceptance. For example, an applicant who has completed a course in marketing or finance must be subject to the validation procedure. For consideration, a course must be completed with a grade of "C" or higher. The College of Management Science will accept transfer business credits without validation only for courses which are equivalent to Accounting I and II, Statistics I and II, Economics I and II, Business Law I and II, and Microcomputers and Applications Software.

Other business courses may be transferred through a validation process which includes a written examination in the specific subject area of the course to be transferred. Certain associate degree courses (e.g., Real Estate) are not transferable as business requirements because they have no comparable equivalent in the Bachelor of Science in Business Administration program; however, such courses can be counted as unrestricted general electives.

I Accounting

Associate of Science Degree - 63 Credits

Suggested Course of Study

First Year

First Semester (September)

Subject Number		Credits
67.201	Accounting Principles I	3
68.201	Economics I (Microeconomics)	3
42.101	College Writing I	3
		9

Second Semester (January)

Subject Number		Credits
67.202	Accounting Principles II	3
68.202	Economics II (Macroeconomics)	3
42.102	College Writing II	3
		9

Second Year

90.112	Concepts in Algebra I	3	90.119	Concepts in Algebra II	3
67.301	Intermediate Accounting I	3	67.302	Intermediate Accounting II	3
42.224	Business Writing	<u>3</u>	67.362	Business Law I	<u>3</u>
		9			9

Third Year

47.101	General Psychology	3	69.331	Business Finance	3
67.411	Cost Accounting I	3	48.101	Introduction to Sociology	3
92.209	Introduction to BASIC or		90.241	Statistical Concepts I	<u>3</u>
92.219	BASIC Programming	<u>3</u>			9
		9			

Fourth Year

69.332	Money and Banking	3
67.....	Accounting Elective	3
.....	Area II Elective	<u>3</u>
		9

II Banking

Associate of Science Degree - 63 Credits

Suggested Program of Study

First Year

First Semester (September)

Subject Number	Credits
42.101 College Writing I	3
67.201 Accounting Principles I	3
69.101 Principles of Banking	<u>3</u>
	9

Second Semester (January)

Subject Number	Credits
42.102 College Writing II	3
67.202 Accounting Principles II	3
69.117 Law and Banking: Principles	<u>3</u>
	9

Second Year

68.201 Economics I (Microeconomics)	3	68.202 Economics II (Macroeconomics)	3
90.112 Concepts in Algebra I	3	90.119 Concepts in Algebra II	3
42.224 Business Writing	<u>3</u>	69.105 Consumer Lending	<u>3</u>
	9		9

Third Year

69.119 Commercial Lending	3	69..... Banking Elective	3
47.101 General Psychology	3	48.101 Introduction to Sociology	3
92.209 Introduction to BASIC or		90.241 Statistical Concepts I	<u>3</u>
92.219 BASIC Programming	<u>3</u>		9
	9		

Fourth Year

69..... Banking Elective	3
69.332 Money and Banking	3
..... Area II Elective	<u>3</u>
	9

III Management

Associate of Science Degree - 63 Credits

Suggested Program of Study

First Year

First Semester (September)

Subject Number		Credits
67.201	Accounting Principles I	3
68.201	Economics I(Microeconomics)	3
42.101	College Writing I	<u>3</u>
		9

Second Semester (January)

Subject Number		Credits
67.202	Accounting Principles II	3
68.202	Economics II (Macroeconomics)	3
42.102	College Writing II	<u>3</u>
		9

Second Year

69.201	Principles of Management	3
42.224	Business Writing	3
90.112	Concepts in Algebra I	<u>3</u>
		9

69.331	Business Finance	3
90.119	Concepts in Algebra II	3
.....	Business Elective	<u>3</u>
		9

Third Year

90.241	Statistics for Business I	3
69.321	Marketing Principles	3
92.209	Introduction to BASIC or	<u>3</u>
92.219	BASIC Programming	9

69.371	Operations Management	3
47.101	General Psychology	3
67.362	Business Law I	<u>3</u>
		9

Fourth Year

69.332	Money and Banking	3
.....	Area II Elective	3
69.451	Personnel Management	<u>3</u>
		9

Students transferring to the Bachelor of Liberal Arts Program may also take 67.311 Managerial Accounting and 67.362 Business Law I after obtaining the Associate Degree.

College of Pure and Applied Science

Arthur C. Watterson, Acting Dean; B.S., Ph.D.

Raymond Hardy, Assistant Dean; B.S., M.S.

Philip S. Lamprey, Chemistry Coordinator, B.S., Ph.D.

Ann Marie Hurley, Computer/Information Systems Coordinator; B.S., M.S.

Alan W. Doerr, Mathematics Coordinator; B.A., M.A.

The College of Pure and Applied Science offers the following Continuing Education undergraduate programs: Associate of Science (Applied Chemistry, Information Systems, Applied Mathematics, Computer Mathematics Option) and Bachelor of Science (Applied Chemistry, Information Systems, Applied Mathematics, Computer Mathematics Option)

I Applied Chemistry

Associate of Science and Bachelor of Science Degrees

Suggested Course of Study

Years 1 - 4 Leading to the Degree of Associate of Science: 64 Credits

First Year

First Semester (September)

Subject Number	Credits
84.121 Chemistry I	3
90.113 College Algebra	3
42.101 College Writing I	<u>3</u>
	9

Second Semester (January)

Subject Number	Credits
84.122 Chemistry II	3
92.115 College Trigonometry	3
42.102 College Writing II	<u>3</u>
	9

Second Year

86.121 Analytical Chemistry A	3
92.125 Calculus A	3
99.131 Technical Physics I	<u>3</u>
	9

86.122 Analytical Chemistry B	3
92.126 Calculus B	3
99.132 Technical Physics II	<u>3</u>
	9

Third Year

84.223 Principles of Organic Chemistry I	3
84.225 Principles of Organic Chemistry Lab I	1
17.127 Electrical Fundamentals	<u>3</u>
	7

84.224 Principles of Organic Chemistry II	3
84.226 Principles of Organic Chemistry Lab II	1
99.133 Technical Physics III	<u>3</u>
	7

Fourth Year

84.344	Physical Chemistry I	3	84.345	Physical Chemistry II	3
86.355	Experimental Physical Chemistry	1	84.347	Physical Chemistry	
.....	Elective	<u>3</u>		Laboratory II	1
		7	.....	Elective	<u>3</u>
					7

All electives must be approved by the Program Coordinator.

Years 5 - 8 Leading to the Degree of Bachelor of Science: 134 Credits

Fifth Year

First Semester (September)

Subject Number	Credits
84.334 Advanced Inorganic Chemistry	3
92.383 Introduction to Statistics	3
42.226 Technical and Scientific Communications	<u>3</u>
	9

Second Semester (January)

Subject Number	Credits
86.352 Chemical Applications	3
..... *Computer Elective	3
..... Area II Elective	<u>3</u>
	9

*An introductory computer course in a programming language other than COBOL.

Sixth Year

86.361	Advanced Organic Chemistry I	3	86.362	Advanced Organic Chemistry II	3
27.201	Plastics Materials Science I	3	69.201	Principles of Management	3
.....	Area II Elective	<u>3</u>	22.295	Materials Science	<u>3</u>
		9			9

Seventh Year

86.471	Industrial Chemistry	3	84.314	Analytical Chemistry II	3
68.201	Economics I (Microeconomics)	3	84.316	Analytical Chemistry Lab II	1
.....	Area I or II Elective	<u>3</u>	68.202	Economics II (Macroeconomics)	<u>3</u>
		9			7

Eighth Year

86.481	Chemistry of High Polymers I	3	86.482	Chemistry of High Polymers II	3
.....	Elective	3	.....	Human Values Elective	3
.....	Elective	<u>3</u>	.....	Elective	<u>3</u>
		9			9

All electives must be approved by the Program Coordinator.

II Applied Mathematics

Associate of Science and Bachelor of Science Degrees

Years 1 - 4 Leading to the Degree of Associate of Science: 72 Credits

Suggested Course of Study

First Year

First Semester (September)

Subject Number	Credits
68.201 Economics I (Microeconomics)	3
90.113 College Algebra	3
42.101 College Writing I	<u>3</u>
	9

Second Semester (January)

Subject Number	Credits
68.202 Economics II (Macroeconomics)	3
92.115 College Trigonometry	3
42.102 College Writing II	<u>3</u>
	9

Second Year

*92.209 Introduction to BASIC or

92.219 BASIC Programming	3
92.125 Calculus A	3
99.131 Technical Physics I	<u>3</u>
	9

92.265 Pascal Programming	3
92.126 Calculus B	3
99.132 Technical Physics II	<u>3</u>
	9

Third Year

92.225 Calculus C	3
92.383 Introduction to Statistics	3
..... Area II Elective	<u>3</u>
	9

92.226 Calculus D	3
42.226 Technical and Scientific Communication	<u>3</u>
..... Human Values Elective	<u>3</u>
	9

Fourth Year

84.121 Chemistry I	3
92.461 Systems Simulation and Modeling	3
92.221 Linear Algebra I	<u>3</u>
	9

84.122 Chemistry II	3
92.222 Linear Algebra II	3
..... Area I or II Elective	<u>3</u>
	9

*92.209 is for students with no prior programming experience: 92.219 is for students with prior programming experience.

Fifth Year

First Semester (September)

Subject No.	Credits
92.234 Differential Equations	3
92.321 Discrete Structures I	3
*..... Technical Elective	3
	9

Second Semester (January)

Subject No.	Credits
92.315 Partial Differential Equations	3
..... Area II Elective	3
*..... Technical Elective	3
	9

Sixth Year

92.362 Numerical Analysis I	3
92.301 Introduction to Applied Mathematics I	3
**+.... Technical Elective	3
	9

92.454 Numerical Analysis II	3
92.302 Introduction to Applied Mathematics II	3
**+.... Technical Elective	3
	9

Seventh Year

+..... Computer Elective	3
..... Mathematics Elective	3
..... Technical Elective	3
	9

+.....Computer Elective	3
..... Mathematics Elective	3
..... Technical Elective	3
	9

Eighth Year

+..... Computer Elective	3
92.411 Complex Variables I	3
..... Technical Elective	3
	9

+..... Computer Elective	3
..... Mathematics Elective	3
..... Technical Elective	3
	9

*Those holding an Associate of Science (Mathematics) must take 92.360 and a computer elective. Those holding an Associate of Science (Computer Mathematics Option) must take 92.221 and 92.222.

**Those holding an Associate of Science (Mathematics) must take 92.455 and 92.462. Those holding an Associate of Science (Computer Mathematics Option) must take 84.121 and 84.122.

+The above courses may be replaced by a sequence of related courses approved by the Program Coordinator.

All electives must be approved by the Program Coordinator.

III Applied Mathematics (Computer Mathematics Option)

Associate of Science and Bachelor of Science Programs

Suggested Course of Study

Years 1 - 4 Leading to the Degree of Associate of Science: 72 Credits

First Year

First Semester (September)

Subject Number	Credits
*92.209 Introduction to BASIC or	
92.219 BASIC Programming	3
90.113 College Algebra	3
42.101 College Writing I	<u>3</u>
	9

Second Semester (January)

Subject Number	Credits
92.263 FORTRAN Programming	3
92.115 College Trigonometry	3
42.102 College Writing II	<u>3</u>
	9

Second Year

68.201 Economics I (Microeconomics)	3	68.202 Economics II (Macroeconomics)	3
92.265 Pascal Programming	3	92.126 Calculus B	3
92.125 Calculus A	<u>3</u>	..... Computer Elective	
	9	(92.364 is strongly recommended)	<u>3</u>
			9

Third Year

92.463 Systems Design and Development I	3	92.464 Systems Design and Development II	3
92.225 Calculus C	3	92.226 Calculus D	3
92.383 Introduction to Statistics	<u>3</u>	99.131 Technical Physics I	<u>3</u>
	9		9

Fourth Year

92.461 Systems Simulation & Modeling	3	92.360 Introduction to Data Structures	3
99.132 Technical Physics II	3	..... Area I or II Elective	3
92.321 Discrete Structures I	<u>3</u>	42.226 Technical and Scientific Communication	<u>3</u>
	9		9

*92.209 is for students with no prior programming experience; 92.219 is for students with prior programming experience.

Fifth Year

First Semester (September)

Subject Number	Credits
92.234 Differential Equations	3
..... Area I Elective	3
*..... Technical Elective	3
	9

Second Semester (January)

Subject Number	Credits
92.455 Assembly Language Programming I	3
..... Area II Elective	3
*..... Technical Elective	3
	9

Sixth Year

92.362 Numerical Analysis I	3
92.301 Applied Mathematics I	3
**..... Technical Elective	3
	9

92.454 Numerical Analysis II	3
92.302 Applied Mathematics II	3
**..... Technical Elective	3
	9

Seventh Year

..... Computer Elective	3
92.462 Systems Programming	3
..... Technical Elective	3
	9

..... Computer Elective	3
..... Mathematics Elective	3
..... Human Values Elective	3
	9

Eighth Year

..... Computer Elective	3
92.411 Complex Variables I	3
..... Technical Elective	3
	9

..... Computer Elective	3
..... Mathematics Elective	3
..... Technical Elective	3
	9

*Those holding an Associate of Science (Mathematics) must take 92.360 and a computer elective. Those holding an Associate of Science (Computer Mathematics Option) must take 92.221 and 92.222.

**Those holding an Associate of Science (Mathematics) must take 92.455 and 92.462. Those holding an Associate of Science (Computer Mathematics Option) must take 84.121 and 84.122.

All Technical Electives must be approved by the Program Coordinator.

IV Information Systems

1. Associate of Science Degree

Associate of Science Degree Requirements: 72 Credits

Suggested Course of Study

First Year

First Semester (September)

Subject Number	Credits
*92.209 Introduction to BASIC or	
92.219 BASIC Programming	3
42.101 College Writing I	3
90.112 Concepts in Algebra I	<u>3</u>
	9

Second Semester (January)

Subject Number	Credits
92.263 FORTRAN Programming	3
42.102 College Writing II	3
90.119 Concepts in Algebra II	<u>3</u>
	9

Second Year

67.201 Accounting Principles I	3
42.224 Business Writing	3
92.365 COBOL Programming I	<u>3</u>
	9

67.202 Accounting Principles II	3
69.201 Principles of Management	3
92.368 COBOL Programming II	<u>3</u>
	9

Third Year

92.265 Pascal Programming	3
68.201 Economics I (Microeconomics)	3
69.331 Business Finance	<u>3</u>
	9

..... Computer Elective	3
(92.364 is strongly recommended)	
68.202 Economics II (Macroeconomics)	3
..... Management Elective	<u>3</u>
	9

Fourth Year

92.383 Introduction to Statistics	3
..... Area II Elective	3
92.321 Discrete Structures I	<u>3</u>
	9

92.360 Introduction to Data Structures	3
..... Elective	3
..... Elective	<u>3</u>
	9

*92.209 Introduction to BASIC is for students with no prior programming experience. 92.219 BASIC Programming is for students with prior programming experience.

Note: Students transferring with an Associate degree in accounting or banking may substitute these courses for the management courses listed above.

2. Bachelor of Science Degree - 124 Credits

A. Required Arts and Sciences Courses - 30 credits

*42.101	College Writing I
*42.102	College Writing II
*42.224	Business Writing
47.101	General Psychology
48.101	Introduction to Sociology
*90.112	Concepts in Algebra I
*90.119	Concepts in Algebra II
*92.321	Discrete Structures I
*68.201	Economics I (Microeconomics)
*68.202	Economics II (Macroeconomics)
92.383	Introduction to Statistics

B. Required Business Courses - 12 credits

*67.201	Accounting Principles I
*67.202	Accounting Principles II
*69.331	Business Finance
*69.201	Principles of Management

C. Required Computer Mathematics Option Courses - 36 credits

*92.209	Introduction to BASIC or
*92.219	BASIC Programming
*92.263	FORTRAN Programming
*92.265	Pascal Programming
*92.360	Introduction to Data Structures
*92.364	Problem Solving with Pascal
*92.365	COBOL Programming I
*92.368	COBOL Programming II
92.455	Assembly Language Programming I
92.462	Systems Programming
92.474	Data Base Concepts
92.477	Information Systems I
92.478	Information Systems II

*Courses fulfilling associate's degree requirements.

D. Management, Accounting or Banking electives - 18 credits

(Concentration in other areas may be chosen with approval of Program Coordinator.)

E. University Core Requirements

Human Values	- 3 credits
Area II Electives	- 6 credits
Science Elective	- 4 credits
Free Electives	- <u>15</u> credits

Admissions

Admissions Procedures into Degree Programs

All adults are welcome to register for credit or non-credit courses in the Division of Continuing Education. There are no admissions requirements for anyone not entering a degree program. Students who decide to pursue an associate's degree or a bachelor's degree must apply for admission to the program through the Office of Continuing Education.

To be considered for acceptance into a degree program, students must hold a high school diploma or a Graduate Equivalency Diploma (GED). Continuing Education operates on a rolling admission basis and each application is reviewed when the student's file is complete. Students must be admitted to a degree program in order to be eligible for most financial aid.

The following materials must be submitted for admission:

1. an application (available in the Office of Continuing Education)
2. official transcripts of all college, university, or post-secondary schools attended
3. from applicants with no previous college/university experience: official transcript of high school records or its equivalent (GED certificate)

After the above information is filed in the Office of Continuing Education, an area coordinator will evaluate the academic records. Students will receive an official letter of acceptance and a preliminary transfer credit evaluation from the Associate Director of Continuing Education within four weeks of submitting academic materials.

Transfer Credit

Students may transfer academic credit completed at other accredited institutions of higher education toward an associate's degree or bachelor's degree. Official transcripts must be sent to the Office of Continuing Education with the application. Credit will be accepted if it is equivalent to University of Lowell instruction, if it is applicable to the intended program, and if the student has received a grade equivalent to a C or higher. Grades of transferred courses will be recorded with the

notation CR which designates that credit has been granted and will not be computed into a student's cumulative grade point average at the University of Lowell. Residency requirements listed in the Academic Policies section of this catalog are also considered when transfer credit is being evaluated. The University of Lowell subscribes to the Massachusetts Transfer Compact and maintains flexibility in the transfer of qualified students of the Commonwealth of Massachusetts.

After acceptance into a degree program, credits transferred from other accredited institutions should be approved by the program coordinator before they can be accepted into a student's program of study.

Declaration of a Major

Upon application, students are requested to declare a major. If students are uncertain about the major they wish to pursue, they should list themselves as "undeclared". A career coordinator is available during evening hours to help students in their selection of a field of concentration.

Student Services

The Division of Continuing Education offers academic counseling and career counseling to assist students in making educational and career choices. Academic advisors and career counselors are available for individual appointments, workshops and special programs. Continuing Education is sensitive to the concerns of adult students and offers the following support services:

Academic Advising

Students who choose to pursue a degree program are assigned an academic advisor. The advisor will outline a program of study, taking into consideration previous academic credit. Although the program advisor will assist students, each student must assume responsibility for observing the curriculum requirements and University policies. Early in their program of study students should arrange an appointment with the program advisor upon admission into a program.

New students, transfer students and students not enrolled in degree programs also may obtain academic advising on course selection and Continuing Education programs and policies. Academic advisors are available to talk to students about courses, transfer credit, degree requirements, and other matters of individual concern.

Advisors are available Monday through Thursday between 4:00 and 8:00 p.m. Students who want to consult a specific advisor should call ahead for an appointment. Day appointments are also available. This service is located in the lower level of Cumnock Hall, North Campus. Appointments can be made by calling (508)452-5000, extension 2221.

Career Counseling

Students who have questions concerning career goals or who are uncertain about the choice of major are encouraged to meet with our career counselor to discuss these concerns. Counselors will guide students through a self-assessment and interest inventory that will provide information helpful in setting career and educational goals. This service is available on an individual basis throughout the academic year by appointment.

Career Development Workshops

Career Development Workshops are held during registration of each semester and are designed to help students who are uncertain about their career choice. Workshop participants will review decision-making skills and identify interests and skills to assist them in their career choices. Information on degree programs and other possible options offered through the Division of Continuing Education will also be discussed. Adults considering a return to school are encouraged to participate in these workshops as well as current students who are undecided about their major. Information about specific dates will be announced prior to each semester.

Other workshops are offered throughout the academic year on such topics as study skills, time management, math anxiety, and job search techniques. These services are available to all students free of charge.

Career Placement

The services of the Placement Office, located in Southwick Hall, North Campus, are available to Continuing Education students during daytime hours. Services include interview and job marketing workshops, career days, and on-campus recruiting interviews. Students should refer to the *Connector* (day school newspaper) for weekly updates on placement services. For a copy of the *Connector* call the Office of Continuing Education.

Students with Disabilities

As a University committed to the principles of equal opportunity, the Division of Continuing Education makes every effort to assist students with disabilities. The University is becoming increasingly accessible to students who are physically disabled. Although some older buildings are still inaccessible to students with limited mobility, classes can be moved to satisfy special needs. Special advising, registration assistance, preferential scheduling, alternative examination procedures, and special parking arrangements are some of the special services available to disabled students. Students who need special arrangements should contact the Associate Director of Continuing Education as soon as possible.

Tutor Referrals

Graduate students and undergraduate seniors are available to tutor Continuing Education students in most academic areas. Students in need of tutoring may call the Student Services Coordinator for a referral. Students are responsible for making time and financial arrangements with the tutor.

Continuing Education Newsletter

The Continuing Education newsletter is available in the fall and spring semesters. The aim of the newsletter is to keep students informed about Continuing Education programs, events and important dates, and to feature the activities of individual faculty, students and alumni of the University.

National Honor Society

The Gamma Delta Chapter of Alpha Sigma Lambda is a national honor society for adult students in Continuing Education. The aim of Alpha Sigma Lambda is to recognize adult students who achieve academic excellence in their course work while performing the many responsibilities associated with their families and careers. Eligibility for membership at the University of

Lowell requires that students rank in the top 10% of all students who meet certain academic requirements. Selections for membership are made during each spring semester and students who are invited to become members are inducted into the Society in May. Membership in Alpha Sigma Lambda provides the University with an opportunity to acknowledge the endeavors of outstanding adult students in the Continuing Education program.

Distinguished Teacher Awards

The Distinguished Teacher Awards were named in honor of a distinguished faculty member, Dr. William E. Haskell, Jr., Coordinator of the Civil Engineering Technology Program. The awards were established to recognize excellence in undergraduate teaching in Continuing Education at the University of Lowell. Awards are based on quality of course content, effectiveness of presentation, and student motivation. Awards are presented annually to outstanding faculty in the areas of Humanities, Engineering, Management, and Science. Students are encouraged to nominate outstanding teachers who have made a positive contribution to their education.



General Information

The Family Educational Rights and Privacy Act

The Family Educational Rights and Privacy Act of 1974 assures confidentiality of educational records containing information on presently enrolled students, a former student or alumni. It also grants to students the right of access to inspect or review their educational files, records, or data. Students who wish to inspect their records must file a "Right of Access" form with the Office of Continuing Education. Within ten days of receipt of this form, the Office will notify the student as to when and where the record may be inspected.

The University, according to FERPA, may make public "Directory Information" about a student (e.g., name, address, date and place of birth, telephone listings, schools attended, degrees and awards received, major field of study, participation in officially recognized activities and sports, and the most previous educational agency or institution). Students who wish to withhold directory information from public distribution must write to the Office of Continuing Education by October 1 of the academic year for which the information would be released.

Educational records concerning individual students may not be released to any individual or agency without written permission of the student; however, Chapter 776 of the Acts of 1975 specifies conditions under which records may be released without permission of the student. These conditions are listed in the University of Lowell Day School Bulletin.

Discrimination and/or Harassment

Federal and state laws require that no student be discriminated against on the basis of age, national origin, race, religion, sex or handicapped, marital, or veteran's status. The Affirmative Action Office, which implements Equal Opportunity/Affirmative Action, is located on the second floor of Dugan Hall (South Campus). The Affirmative Action Office deals with discrimination and harassment complaints and also with the monitoring of actual practice and written policies and procedures, (e.g., student activities, course offerings, teacher and student attitudes).

Sexual harassment of students by faculty, administrators, other employees, or fellow students is a

form of sexual discrimination prohibited by Massachusetts Fair Practices Act, Title VII of the 1964 Civil Rights Act, and Title IX. Any student who believes that he or she has been discriminated against or harassed or who believes that the University is operating in a manner which adversely affects females, handicapped, minority students, or veterans should contact the Affirmative Action Office immediately.

Absences Due to Religious Beliefs

Any student who is unable, because of religious beliefs, to attend classes or to participate in any examination, study, or work requirement on a particular day shall be excused and shall be provided with an opportunity to make up the missed work, provided that such makeup does not create an unreasonable burden upon the school. No adverse or prejudicial results shall come to any student who invokes the provisions of this section of Massachusetts General Law (Chapter 151C, 2B).

Hazing

The planning of and participation in hazing is prohibited according to Chapter 536 of the Massachusetts Acts of 1985. Hazing is any conduct or method of initiation into any student organization which willfully or recklessly endangers the physical or mental health of any student or other person.

Policy Changes

Although the Office of Continuing Education tries to provide notice on all policy changes, the University reserves the right to change any policy stated in this bulletin. The University reserves the right to close a course registration, cancel a course, alter the schedule or faculty listing, implement new rules and regulations, and to make changes of any nature in its program, calendar, procedures and standards, and degree requirements without formal notice.

The Office of Continuing Education periodically releases special announcements or changes from departments, colleges, and the University and, when feasible, directs instructors to read or distribute these in classes. Administrative policies of a system-wide nature (e.g., admissions policies, tuition, and fees) are subject to change by the Board of Trustees of the University of Lowell and the Massachusetts Board of Regents of Higher Education without advance notice.

Financial Assistance and Expenses

The opportunity for an education should not be determined by one's economic status. As the cost of higher education increases, more students must depend on financial assistance to supplement their financial resources. The Division of Continuing Education provides access to financial assistance to students whose financial resources are limited. For most financial assistance, students must be matriculating and enrolled in at least six credit hours each semester. For information regarding eligibility, contact the Office of Financial Aid or the Office of Continuing Education.

Commonwealth Employees Tuition Remission

Certain collective bargaining agreements allow employees of the Commonwealth of Massachusetts, and, in some cases, their dependents, to take courses at a 50% reduction in tuition. Students who might be eligible for such a program should consult their personnel director for guidelines for proper enrollment criteria and procedures. Verification of eligibility on appropriate forms must be presented at the time of registration for classes.

Senior Citizens

Senior Citizens are invited to register for academic courses. Continuing Education will waive all tuition for persons over the age of 60, subject to the availability of seats in the class.

Financial Aid Programs

The financial aid available to eligible students at University of Lowell includes the five major federal student assistance programs:

- Pell Grant (formerly the Basic Education Opportunity Grant)
- Supplemental Educational Opportunity Grant (SEOG)
- Perkins National Direct Student Loan (NDSL)
- College Work-Study Program (CWSP)
- Guaranteed Student Loan (GSL)

The Commonwealth of Massachusetts institutional financial assistance programs include:

- Massachusetts State Scholarship Program
- Board of Regents Tuition Remission Program
- Massachusetts Adult Learners Program
- Massachusetts Educational Employment Program
- Massachusetts Part-Time Student Grant Program

Veteran and National Guard Benefits

All students entitled to benefits under federal and state law must 1) complete the application for admission form, and 2) declare a major program of study in order to be eligible for these benefits. In addition, all veterans must submit a transcript of all post-secondary education or proof of a high school diploma or GED equivalency before registering in any program.

Veterans who are entitled to educational benefits under federal law and are attending the University for the first time must submit appropriate forms to the Office of Continuing Education. Forms are available in the Office of Continuing Education or the local Veterans' Administration Office. Veterans who have not previously used benefits must also submit a DD214, and, if applicable, a marriage certificate and birth certificates of children.

Veterans who were in active service prior to July 1, 1976 and either entered from Massachusetts or can prove two consecutive years (minimum) residency are entitled to tuition exemption. To file, the student must submit with their registration either a Form 10 (available through the Department of Education - War Records) or a copy of DD214 and proof of residency.

The Army National Guard has a tuition assistance program (ACEA) that applies to Continuing Education. The program covers 75-90% of costs. Eligible students must submit a DA2171 form with their registration. This form can be applied for through the unit commander's office.

Tuition and Fee Information

Tuition is priced on the basis of credit hour unless contact hour is different. Tuition is then based on the listed contact hour.

Registration	\$15.00
Tuition (per credit/contact hour)	\$75.00
Late Registration Fee	\$10.00
Laboratory Fee	\$25.00

Tuition Refund Schedule

Refunds of tuition, if any, are made on the basis of the date and time of receipt of a student's official withdrawal. Any eligibility for tuition refund is based on the academic calendar, not class atten-

dance, and is prorated as follows:

Withdrawal before first class meeting	100%
Before the second class meeting	90%
Before the third class meeting	50%

Fees are not refunded unless Continuing Education is responsible for cancellations.

Late Fee

A late registration fee of \$10.00 is charged to any student who registers after the regular registration period, which is published in each semester tabloid of course listings. This fee is assessed in addition to the usual registration fee and is not refundable.

Payment of Bills

All payments are due at the time students register for classes. A student who is in debt to the University at the end of any semester or summer session may not register for another term or receive transcripts or grade reports until the balance is paid. Registrations for such students may be cancelled without notice.



Academic Policies and Procedures

General Requirements for Baccalaureate Studies

University policy requires all degree candidates to comply with the following standards:

1. mastery of at least one discipline, field of knowledge or applied professional area;
2. competence in writing the English language;
3. an understanding of the humanities, social sciences, mathematics, and science;
4. a familiarity with problems and issues of value and choice.

All baccalaureate candidates are required to earn a 2.00 (C) cumulative average in their total course of study, to complete a minimum of 120 semester hours of course credits, to fulfill the residency requirements, to conform to the general regulations and requirements of the University, to satisfy the regulations and academic standards of the colleges which exercise jurisdiction over the degrees for which they are matriculating, to satisfy the curriculum requirements established by the departments or programs in their major, and to complete the University core requirements.

University Core Requirements

A. English Composition Requirement (six semester credits)

All students must pass a sequence of two courses totaling six semester hours in composition (42.101 College Writing I and 42.102 College Writing II).

B. Area Distribution Requirements (27-29 semester credits)

All students must pass a minimum of nine courses (a total of 27 to 29 semester credits) in the area distribution requirements. A student whose academic major falls in a discipline listed under Area I, II, or III, or whose professional major is related to one of these disciplines, is exempted from the distribution requirements for courses in that area. In fulfilling the core requirements, a student is limited to a maximum of two courses in any one department. Additionally, a student is limited to two courses in literature. Pass/no-credit courses may not be counted toward the completion of the area distribution requirements.

1) A minimum of two courses (six semester credits) must be completed in each Area I and Area II, plus two additional courses (six semester credits) selected from either or both of these areas.

Total : six courses or 18 semester hours

Area I Courses: Social and Behavioral Sciences

- 43.105 Western Civilization
- 43.106 The Modern World
- 43.111 United States History to 1877
- 43.112 United States History Since 1877
- 43.228 The American Indian
- 43.239 American Economic History
- 43.304 Recent U.S. History, 1940 to the Present
- 43.308 History of Crime, Conflict and Social Control In the U.S.
- 43.314 Society and Culture in the Early Middle Ages
- 43.324 The Rise of Industrial America
- 46.101 Introduction to American Politics
- 46.121 Introduction to International Relations
- 46.282 Contemporary Political Theory
- 47.101 General Psychology
- 47.163 The Human Life Span
- 47.209 Social Psychology
- 47.232 Psychology of Personality
- 47.255 Community Psychology
- 47.262 Adolescent Psychology
- 47.272 Abnormal Psychology
- 47.328 Dynamics of Interpersonal Relations
- 47.335 Psychology of Women
- 47.364 Psychology of Crime and Corrections
- 48.101 Introduction to Sociology
- 48.201 Social Anthropology
- 48.231 Sociology of the Family
- 48.234 The Study of Minorities
- 48.241 Sociology of Women
- 48.341 Social Stratification
- 48.361 Sociology of Law and the Criminal Justice System
- 59.203 Technology & Human Values I
- 59.204 Technology & Human Values II

- 68.201 Economics I (Microeconomics)
- 68.202 Economics II (Macroeconomics)
- 68.307 Government, Business and Society

Area II Courses: Fine Arts and Humanities

- 42.201 Great Books of Antiquity
- 42.202 Great Books of the Modern Period
- 42.203 Great Books of the Modern Period
- 42.212 The Short Story
- 42.217 The Horror Story
- 42.267 Introduction to Shakespeare
- 42.291 History of English Literature I
- 42.292 History of English Literature II
- 42.294 History of American Literature I
- 42.295 History of American Literature II
- 42.317 British Literature of the Twentieth Century
- 45.201 Introduction to Philosophy
- 45.202 Introduction to Logic
- 45.203 Introduction to Ethics
- 50.211 Intermediate Conversational French I
- 50.212 Intermediate Conversational French II
- 54.211 Intermediate Conversational Spanish I
- 54.212 Intermediate Conversational Spanish II
- 57.251 Visual Design I
(not for students in College of Engineering)
- 57.255 Drawing I
(not for students in College of Engineering)
- 58.101 Appreciation of the Visual Arts
- 58.203 Survey of Art I
- 58.204 Survey of Art II
- 59.205 Human Values in Western Culture I
- 59.206 Human Values in Western Culture II

2) A student must also complete a minimum of three courses (nine to eleven semester credits) in Area III. One course must be in a laboratory science, a second course must be in mathematics, and a third course must be in science or mathematics.

Students who wish to satisfy the core requirement for a laboratory science must register for the corequisite laboratory wherever applicable. If a student elects to take a science without the laboratory component, it will not satisfy that part of the University core requirement of one laboratory science course.

Total: three courses or nine to eleven semester credits

Area III Courses: Science

- 83.101 Life Science I
- 83.102 Life Science II
- 83.103 Life Science Lab I
- 83.104 Life Science Lab II
- 89.101 General Geology I
- 89.102 General Geology II
- 89.103 General Geology Lab I
- 89.104 General Geology Lab II

Area III Courses: Mathematics

- 92.265 Pascal Programming
- 92.383 Introduction to Statistics

C. Human Values Requirements (3 semester credits)

All students are required to pass one Human Values course listed below unless a department indicates that the human values requirement is satisfied by a designated department requirement.

Human Values Courses

- 42.205 Human Values in Western Culture I
- 42.206 Human Values in Western Culture II
- 45.201 Introduction to Philosophy
- 45.203 Introduction to Ethics
- 46.282 Contemporary Political Theory
- 47.209 Social Psychology
- 48.201 Social Anthropology
- 48.234 The Study of Minorities
- 48.241 Women in Society
- 59.203 Technology and Human Values I
- 59.204 Technology and Human Values II
- 68.307 Government, Business and Society

Residency Requirements for Baccalaureate Studies

In addition to satisfying specific course and achievement requirements, each baccalaureate candidate must complete at least 15 semester hours in regular course work within the major department of the University for each major which is presented for a degree with a 30 semester hour minimum completed at the University. This 30 semester credit minimum may include established course equivalency procedures and authorized day courses in the University.

Each candidate for a baccalaureate degree must also satisfy one of the following residency requirements:

- 1) Complete an associate's degree under the provisions of the Massachusetts Transfer Compact in a Massachusetts Community College, earning not more than 60 semester credits, and the remainder in courses at the University, earning not less than 60 semester credits.
- 2) Complete up to the first two years in an accredited associate institution earning not more than 60 semester credits (C grades or better), and the remainder in courses at the University, earning not less than 60 semester credits.
- 3) Complete the equivalent of the first three years of a baccalaureate program in an accredited four-year institution, earning not more than 90 semester credits (C grades or better) and the remaining courses at the University, earning not less than 30 semester credits.
- 4) Complete 90 or more semester credits at the University and complete the remainder of the prescribed course of study at another accredited institution, earning not more than 30 semester credits at that institution.

A student who has already earned a baccalaureate degree may be admitted to the University to pursue an additional baccalaureate degree in accordance with the following: 1) the nomenclature of the additional degree to be pursued must be distinctly different from the previously conferred degree (e.g. Bachelor of Arts, Bachelor of Science, etc.), 2) the major field of the previous degree must be clearly distinct from that of the additional degree, 3) the work for the additional degree must include the Continuing Education residency requirements, 4) the final 30 credits

presented for the additional degree must be in addition to and independent of any previous baccalaureate, 5) a minimum of 15 credits must be taken at the University in the major field which is presented for the additional degree, and 6) a minimum of 30 semester hours must be completed at the University.

Residency Requirements for Associate Studies

In addition to meeting all the course requirements of an associate's degree, candidates must adhere to the following residency requirements:

- 1) Each student must complete at least nine semester credits in regular coursework in his/her major department and must complete a total of 21 semester credits through the Division of Continuing Education.
- 2) A student may pursue an additional associate's degree under the same regulations set forth for pursuing an additional baccalaureate degree (see above) except that the total number of credits to satisfy the residency requirement is 21.



Academic Standing

Grade-Point Requirements

Each student is subject to the following grade-point requirements for the specified numbers of completed course hours. These grade-point averages are minimum University requirements. Individual colleges or departments may establish higher standards.

Course Hours Attempted*	Grade-Point Averages for Satisfactory Standing	Grade-Point Averages for Academic Warning	Grade-Point Averages for Academic Suspension
12-30	1.500	1.400-1.499	1.399 or below
31-45	1.600	1.500-1.599	1.499 or below
46-60	1.700	1.600-1.699	1.599 or below
61-75	1.800	1.700-1.799	1.699 or below
76-90	1.900	1.800-1.899	1.799 or below
91-graduation	2.000	1.900-1.999	1.899 or below

* Included in "Course Hours Attempted" are all course credits which have been granted (including credits awarded through transfer and challenge by examination, course credits which have been awarded with grades) and all hours of course work which have been failed with the qualitative letter grade of F.

Specified Grade-Point Averages are computed solely on the basis of those courses completed at the University of Lowell or through University auspices under previous policies which governed authorized off-campus study and which were qualitatively evaluated with the following letter grades: A, AB, B, BC, C, CD, D, and F.

At the end of each official grading period, the Office of Continuing Education automatically evaluates the cumulative averages of all matriculating students for compliance with University retention standards. Students whose cumulative grade-point averages are below retention requirements at the end of any official grading period have not made satisfactory academic progress and are so notified on their computerized grade report. Students whose cumulative grade-point averages fall below the requirements for their attempted course credits by more than 0.10 are immediately suspended. Students whose cumulative grade-point averages are not more than 0.10 below the requirements for their attempted course credits are placed on academic warning. Students who have been placed on academic warning must achieve satisfactory standing upon the completion of 15 additional hours of course work or they will be suspended from the University.

Academic Probation

A student who has been suspended from the University as a matriculating student in Continuing Education is entitled to apply to the Office of Continuing Education for readmission as a probationary student in accordance with procedures enumerated under the admission policy heading Probationary Readmission. Students who are readmitted on probation will receive a letter from the appropriate Academic Standards Committee which specifies their probationary courses and the academic average they must achieve during their probation in order to achieve satisfactory academic standing.

A student who achieves the required academic average during his or her probation is automatically reinstated in satisfactory academic standing. A student whose average falls below the requirement by no more than 0.10 may be granted an extension of the probation, permitting completion of an additional 15 credits. Such extension would be made by the appropriate Academic Standards Committee during the period between semesters. Students who are granted such extensions will be notified in writing prior to the beginning of classes for the following semester. Students who fail to satisfy probationary standards and are not granted

extensions, and students who are granted such extensions and fail to achieve satisfactory academic standing by the end of the designated period are permanently dismissed from the University and are subsequently barred from attending both day and evening courses.

Students who have been readmitted on probation may not invoke University regulations which govern course repetition for the purpose of deleting course grades from cumulative averages. Nor may they withdraw from any course unless they withdraw from the University with permission of the Associate Director of Continuing Education for reasons of an emergency or medical nature. A probationary student who withdraws from any course without authorization of the Associate Director of Continuing Education cannot by definition satisfy the conditions of his or her probation and will be permanently dismissed from the University at the end of the current semester of enrollment.

Probationary students who receive course evaluations of I (incomplete) and who fail to make up their work under the regulations of an I grade are advised that they may not qualify for extension of their probation, may not register for nor attend University courses (including summer courses), and may not receive authorization to pursue off-campus studies until a final determination of their status has been made.

Accordingly, probationary students are advised that they should not delay completion of course work until the make-up deadline which has been established for students in satisfactory academic standing unless they wish to postpone resumption of their studies. Students who have received permission of the Associate Director of Continuing Education to extend their make-up period are advised that such authorized extension does not waive the requirement for a final determination of academic standing which is based upon grades for all probationary courses.

Following the attainment of satisfactory academic standing and removal from probation, a student who has failed a course during the two semesters preceding suspension and has repeated and passed such a course during the probationary period may retroactively invoke the provision which permits deletion of the course failure from the cumulative grade-point average.

Probationary Readmission

A student who has been suspended from the University as a student in Continuing Education is entitled to apply for readmission as a probationary student but may not resume studies until after an absence from the University of one semester. Application for such readmission to all programs is made through the Office of Continuing Education in accordance with prescribed procedures and must be received by April 1 for readmission decision during the Fall Semester and by November 1 for readmission decision during the Spring Semester. Petitions which have been received by the filing deadline of November 1 will be reviewed by the Academic Standards Committee during the Fall Semester and readmitted students will be permitted to initiate their probationary studies at the beginning of the Spring Semester. Similarly, petitions which have been received by the filing deadline of April 1 will be reviewed by the Academic Standards Committee during the Spring Semester and readmitted students will be permitted to initiate their probationary studies at the beginning of the Fall Semester. The Academic Standards Committee may authorize a Continuing Education student to initiate probationary studies during the summer school if the student made such a request when filing an application for readmission.

In determining such requirements for probation, the Academic Standards Committee shall prescribe a sufficient number of courses (12 to 18 credits) which shall make the achievement of satisfactory academic standing reasonably possible during the designated probationary period. For complete information regarding Academic Standing, refer to the General Catalog of the University of Lowell.

Warning — Students who attend another institution while on suspension from the University must petition to have their courses accepted for transfer credit only after successful completion of the probationary period. Inasmuch as these courses would have been taken without permission of the curriculum coordinator, it is possible that such a petition could be denied.

Day School Students

Day School students of the University of Lowell who are on academic suspension may not take courses through Continuing Education. Suspended students who wish to transfer to Continu-

ing Education must consult with the Associate Director of Continuing Education prior to applying for readmission.

After securing recommendations from appropriate program coordinators and studying the previous academic record of the student, the Academic Standards Committee will set the conditions for probation (courses to be taken, conference schedules with the program coordinators, etc.). Since program transfer is permitted only for students in satisfactory standing, students who have been suspended for inadequate scholarship may apply for readmission as probationary students.

Administrative Dismissal

A student may be dismissed from the University through cancellation of registration for due cause, through expulsion for academic dishonesty, and through disciplinary procedures for violations of good conduct.

Non-Academic Dismissal

Dismissal may be invoked when a student fails to comply, after due notice, with an administrative requirement of the University. Administrative

dismissal is noted on the permanent record card for each course registration by the symbol Y. An administratively dismissed student who wishes to be reinstated must file an application for readmission with the Office of Continuing Education. Reinstatement will be granted only if the condition which has necessitated administrative dismissal has been corrected to the satisfaction of University officials. Examples of conditions which may justify administrative dismissal include: forgery or fraudulent use of University records, documents or forms (including unauthorized access to restricted computer files); non-payment of official University fiscal obligations and failure to comply with administration order relating to the safety of persons or the protection of University property.

Academic Dismissal

Students who have evidenced academic dishonesty, including cheating and plagiarism, may be expelled from the University and shall fail those courses in which dishonesty has taken place. University departments and colleges established procedures and penalties (up to and including administrative dismissal) for adjudicating charges of academic dishonesty .

Course Equivalency Examinations

Subject to specified policies of academic departments, qualified degree candidates are given the opportunity to demonstrate their special competencies and to receive University credit for such competencies through established course equivalency procedures without having to fulfill classroom or faculty course requirements. The University recognizes two types of course equivalency for which credit is awarded. These are 1) College Level Examination Program (CLEP), and 2) departmental examinations.

Students may not receive credit for a specific proficiency examination 1) if they have registered at the University in the course which that examination represents, 2) if they have previously received a University grade for that course or a course in sequence above the course for which they wish to take the examination, 3) if they have previously attempted an equivalent course at another institution and, 4) if a general examination is related to the student's academic major. Students may apply for course equivalency credits up to a maximum of 42 credits; however, the total

number of equivalency and transfer credits may not exceed 90 credits for the baccalaureate degree. Nor may transfer students present equivalency credits in fulfillment of the major field residency requirement of 15 credits in University courses or the general residency requirement of 30 credits.

Course equivalency credits can be awarded through successful completion of the College Level Equivalency Program (CLEP) examinations. CLEP is a national program of credit-by-examination that offers the opportunity to obtain recognition for college level achievement, no matter when, where, or how learning has been acquired. These examinations can be taken in general subject areas or in specific subject areas. If the results of the examination(s) are acceptable to University guidelines, college credit is given toward an undergraduate degree.

General Examination of CLEP may be presented for credit if scores of 500 or better have been obtained. A student who achieves a score of 500

or above in the English Composition examination satisfies the requirement for College Writing I. Credit for the Mathematics examination may be granted only to students who matriculate for degrees in the College of Liberal Arts and the College of Music. Credit for the Natural Sciences examination may be granted only to students who matriculate for degrees in other than the colleges of Engineering, Health Professions, and Pure and Applied Science. Also, credit in the Natural Sciences examination does not satisfy the specific laboratory requirements of the University Core Requirements.

Examination	Maximum Credits Allowed/Semester
English Composition	3
Mathematics	6
Natural Sciences	6
Social Sciences	6
Humanities	6

Continuing Education students who are interested in taking subject examinations of the College Level Examination Program should secure petition forms from the Office of Continuing Education which must be approved by their program coordi-

nator prior to the administration of the exam. Application to take approved subject examination may be obtained in the Office of Continuing Education. CLEP tests are administered at the University during the third week of each month. Please note that the College of Liberal Arts does not recognize and will not award credit for CLEP test in a foreign language offered to satisfy the language proficiency requirement.

Departmental Examinations

Students interested in taking departmental examinations must first arrange an interview with the appropriate coordinator, at which time they must present evidence that they possess sufficient competency to warrant a departmental examination. Departmental examinations will not be given if a corresponding CLEP examination is available. Departments reserve the right to refuse the granting of credit by examination for those courses which are presented by students for their major. When written permission is given to a student to take a departmental examination, the conditions of the examination will be set forth. A \$35.00 fee must be paid before taking the examination.

Grading Information

Grading System

The following qualitative letter grades are employed by the University to characterize the quality of a student's work in a course:

		Quality Points
A	work done by the student is superior and is of the highest honors quality;	4
AB	the work done by the student is less than superior but is completed with a level of distinction which is higher than the basic honors level;	3.5
B	basic honors quality;	3
BC	less than honors quality but is better than satisfactory;	2.5
C	satisfactory work which conforms to the general expectations of the University for baccalaureate study;	2
CD	less than satisfactory and below graduation standards but is better than the minimum requirement for passing a course;	1.5
D	minimum requirement for passing a course;	1
F	course failure	0

In addition to the above letter grades, the following symbols are also used to designate special enrollment provisions or course statuses and do not affect the student's academic average:

S	satisfactory completion of a practicum experience course with a grade of C or higher;
U	unsatisfactory performance in a practicum experience course with a final course grade of less than C;
W*	official withdrawal from a course within the established deadline;
I**	not completed;
X	withdrawal after the deadline for approved reasons of an emergency or medical nature;
Y	administrative dismissal for other than academic reasons;
AU	registration for a course on an "audit" basis and maintenance of attendance record throughout the semester which is sufficient to warrant an official recognition of course attendance.

Withdrawal*

W is not an academic grade but a symbol designating official withdrawal from a course within the established deadline of the eighth week of class of a semester. Official withdrawal is accomplished by filing a withdrawal form in the Office of Continuing Education. A notation of W cannot be given for unofficial withdrawal from a course or for unofficial withdrawal from the University. Accordingly, a student who registers for a course and is carried on an official class roster after the eighth week of a semester must be graded in terms of the completion of the instructor's total course requirements even though the student did not attend any class meeting or unofficially left the University before the eighth week of the semester. A student who wishes to withdraw from a course after the deadline of the eighth week must submit a petition to the Office of Continuing Education. An X will be given only when it can be demonstrated that extended illness or a critical personal emergency of an extended nature prevented that student from complying with official withdrawal procedures. Students receiving benefits from the Veterans Administration are not eligible for retroactive withdrawal from courses.

Incomplete**

all outstanding work rests entirely with the student. The Incomplete notation carries with it a reserve letter grade; if all outstanding work is not acceptably made up and submitted within a four-week period following the final examination, the incomplete will automatically become whatever the instructor has designated as this reserve grade. If the work is satisfactorily completed within the designated time, the instructor will replace the I notation (and its reserve grade) with an appropriate letter grade. Outstanding work may be made up after the four-week period, but arrangements for this make-up must be completed within the original four-week period and permission of the Associate Director of Continuing Education must be obtained for the extension of time.

Repeated Course Work

Students must repeat and pass all required courses which they have failed. Any failed course which is a prerequisite for another must be repeated and passed before the student can take the advanced course.

Students may repeat a limited number of courses in which they received a grade of F and have the repeated grade substituted for the original grade in the computation of the cumulative grade-point average. Non-probationary students must repeat courses within 30 semester hours (equivalent to 2 semesters of full-time study) following their course failures. Although probationary students may not invoke the grade substitution provision during their periods of probation, they may invoke the grade-substitution process upon removal from probation. Students entering as freshmen or

transferring with less than 60 semester credits are permitted a maximum of 10 credits of course repetition for grade substitution; students transferring with 60 or more semester credits are permitted a maximum of 7 credits of course repetition for grade substitution. Students must designate by petition which courses are being repeated for the purpose of grade substitution before re-enrolling.

Prior to an initial determination of academic progress, a student may not repeat courses for grade substitution. Students may repeat a passed course within the provisions of the grade substitution role cited above; however, if the grade of the repeated course is less than the original grade, both grades will be used in computing the grade point average.

Size of Class

Those classes which do not register a minimum of 15 students may be canceled. The number of enrollments during preliminary registration is an important factor in determining the schedule of courses. Thus, to ensure the scheduling of desired courses, students are urged to take advantage of the early registration policies as scheduled in each semester tabloid of class listings.

Prerequisites

Prerequisites indicate the course background expected of students and are listed for their benefit. Students should make certain that they have the necessary prerequisites for each course. Failure to consider prerequisites may result in being inadequately prepared to take the course.

Class Standing

Class standing is determined by a student's total number of credit hours completed toward their program of study.

Freshman Standing	0-29 credit hours
Sophomore Standing	30-59 credit hours
Junior Standing	60-89 credit hours
Senior Standing	90 credits or more

Attendance

Students must attend 80 percent of all classes held in their courses. More than three unexplained absences may cause a student to be dropped from the class enrollments with a grade of F in the course. Examinations or other work missed by absence may, at the option of the instructor, be made up or failed (except for provisions provided by absences due to religious reasons).

Non Matriculation

Students who wish to register for classes but not be admitted into a degree program may do so provided they have the necessary prerequisites. Tuition will be charged at the regular rate, and credit will be awarded for the successful completion of such courses. If the student chooses to become a degree candidate, the applicability of such course(s) may be subject to other policies of the University and/or to specific program requirements. Attendance in courses does not constitute admission to a degree program. In order to matriculate, students must complete the admission process as described in the Admissions section of this catalog.

Class Schedule

Classes in the Division of Continuing Education undergraduate degree programs are scheduled from 7:00 to 10:00 p.m. on Monday, Tuesday, Wednesday and Thursday evenings as listed in each semester tabloid which lists the course offerings. Summer classes are scheduled two evenings a week; Monday and Wednesday, or Tuesday and Thursday from 7:00 to 10:00 p.m. Any other variations will be also stated in the tabloid.

Transcripts and Reporting of Grades

Grade reports are mailed by the Office of Continuing Education to the address listed on the student's registration form as soon as possible after the end of each semester. University policy does not allow grades to be given over the phone. Students may file for official transcripts by completing the written form available in the Office of Continuing Education. The first two transcripts are sent free of charge. Any subsequent transcripts are \$2.00.

Audit

Credit may not be earned in courses which have been audited except by re-enrollment for credit and completion of the course with a passing grade. Students who elect to audit a course may attend classes but are not permitted to take any tests or examinations or turn in any written assignment. No grade will be given and students will receive the notation AU on the transcript. Permission of the Associate Director must be obtained in order to take a course by audit. Language, writing, laboratory, computer mathematics option, or studio art courses cannot be taken for audit. Audit fee is one half the cost of credit tuition.

Student Responsibility

It is the student's responsibility to become familiar with all the regulations and procedures required by the academic program being pursued. In no case should students expect waiver or exception to published program requirements by pleading ignorance to the regulation or asserting that an advisor or other authority did not correctly present the information. All students are expected to become familiar with the general academic information section of the Catalog and the specific program requirements.

Students must pay for University equipment which they have broken or damaged, provided that such breakage does not occur while the student is under

direct supervision of the instructor. In some instruction, students are required by law to wear safety glasses or other safety devices. The instructor of such classes will inform students of their obligation to obtain and wear the necessary safety protection.

Academic Integrity

Students in the Division of Continuing Education are expected to be honest and to respect ethical standards in meeting their academic assignments and requirements. A student who cheats or plagiarizes on an examination or assignment is subject to administrative dismissal.

Graduation Information

Graduation Interview

Students anticipating graduation in the 1988-89 Academic Year must arrange for a graduation interview at the Office of Continuing Education early in the fall semester. Students who expect to complete their degree requirements in the fall must complete the interview by October 28. Students who expect to complete their degree requirements in the spring semester or summer terms must complete their interview by February 24. Students must complete these interviews by the specified deadlines to ensure that their name is included in the graduation program and that their diploma is available at graduation time.

Commencement Fee

A fee of \$48.50 is required of graduating students and is payable on or before registration for the final semester in which the student qualifies for the degree. The fee covers the cost of the diploma and the cap and gown for the graduation ceremony.

Awarding of Degrees

The University awards degrees three times a year: 1) for students completing degree requirements during spring semester, the degrees are awarded in June and the diploma is available to students in June; 2) for students completing degree requirements during the fall semester, the degrees are awarded in February and diplomas available to students in March; and 3) for students completing degree requirements during the summer term, the degrees are awarded in October and diplomas available to students in December.

Those who wish to submit verification of degree completion to employers or to graduate schools during the period between the end of their final grading period and the conferring of degrees may obtain a letter of completion from the Associate Director of Continuing Education. Duplicate diplomas are not issued to students.

University Honors

The University awards degrees with three levels of distinction upon those graduating students who have exhibited exceptional scholastic records. To graduate with honors a student must have achieved a minimum grade point average of 3.00 for all courses completed at the University and must have earned a minimum of 60 semester credits at the University as upperclass students, or a minimum of 30 semester credits for the associate's degree. Additionally, students for both associate's and bachelor's degrees must qualify for the percentile distribution cited below as applied by each college to its total number of graduating students.

Summa Cum Laude

99th through the 98th percentiles

Magna Cum Laude

97th through the 90th percentiles

Cum Laude

89th through the 75th percentiles

University Commencement

Graduation exercises are held once a year at the end of the spring semester. Undergraduates who have completed requirements during the preceding fall semester, who complete degree requirements during the current spring semester, and who anticipate completion of degree requirements during the next immediate summer term are encouraged to attend commencement exercises and their names are listed in the commencement booklet. All students are invited to attend graduation exercises. However, the fee is due regardless of attendance.

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Engineering Technology Mission Statement

Engineering Technology is that part of the technology field which requires the application of scientific and engineering knowledge and methods combined with technical skills in support of engineering activities; it lies in the occupations spectrum between the craftsman and the engineer at the end of the spectrum closest to the engineer. Engineering Technology programs are primarily concerned with producing graduates to work with and manage machines, materials, processes, people and money for industrial firms. Thus, engineering technicians or technologists work in such areas as product sales and distribution, operation service and maintenance, manufacturing and production and routine design.

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Continuing Education
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